Nature

A WEEKLY

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VOLUME CXVIII

"*To the solid ground*
Of Nature trusts the mind that builds for aye."—WORDSWORTH.

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

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Of Nature trusts the mind which builds for aye."—WORDSWORTH.

SATURDAY, JULY 3, 1926.

CONTENTS.

Taxation of Research.

THE question of the taxation of educational and scientific institutions has very recently come prominently before the public, and indications exist that the Treasury is contemplating an important change in connexion with the policy hitherto pursued in granting exemption from income-tax to such institutions. The recent judgment of the House of Lords in the case of the Brighton College *v.* Marriott amounts to a declaration that any profits of an educational establishment which are used for educational purposes are the result of carrying on a trade and therefore taxable. The judgment in question may have far-reaching consequences, for it must be remembered that Brighton College is not only a public school, but also a "charitable institution." Following closely on the above-mentioned judgment comes the public announcement from responsible officers of the Chemical Society of the receipt by this Society of a notification that the Inland Revenue authorities are about to challenge its right, as a "charitable institution," to recover the tax deducted at the source from the interest on its invested capital (see NATURE, June 19, p. 859).

The matter was carried a stage further on June 21, when the question of exempting certain classes of educational institutions from income-tax in respect of any profits forming part of their income which was applicable to educational purposes *only*, was raised in the House of Commons in connexion with the suggested new clauses to the Finance Bill (see "Parliamentary Debates," vol. 197, No. 86). The Chancellor of the Exchequer, in dealing with the matter during the debate, indicated that he was unwilling at the present time to extend the limits of exemption of 'charities,' and admitted that, in view of the judgment in the Brighton College case, it was likely that some institutions which in the course of previous years had not been called upon to pay, might, during the course of the year, on the merits of the particular case, be brought into the ambit of taxation for the first time.

Although unable to hold out any expectations that he would make any proposal before the report stage of the Bill, Mr. Churchill stated that he could not feel that the present restrictions, though necessary, were the last word that should be said in defining what was a 'charity' deserving of exemption from income-tax and what was not; he undertook, therefore, to examine very carefully whether the frontiers of charitable exemptions could not be defined with some nearer approximation than at present.

The question of the exemption of 'charities' from income-tax is briefly reviewed in the Report of the Royal Commission on the Income Tax (1920, Cmd. 615, p. 67; H.M.S.O., 3*s*. net); *inter alia*, the Commissioners say: "The issues involved in this matter are very wide; we have taken no evidence on the general question and we think it is not covered by our Terms of Reference. We therefore content ourselves with expressing the opinion that for the purposes of Income Tax 'charities' should be specifically defined by Parliament." It is to this recommendation, then, that Mr. Churchill has undertaken, if it is possible effectively to do so, to give effect. It is perhaps significant that the Commissioners point out that "attempts made in the past, notably by Mr. Gladstone in 1863, to repeal or curtail the relief enjoyed by charities aroused strong opposition and that in the end nothing was done"; they further state that "any proposal for limiting the exemption would have a serious effect upon the available income of many institutions." It is hoped that Mr. Churchill will give due weight to the foregoing observations.

The legislature has not entirely overlooked in its taxing statutes the claims of scientific institutions, as such; indeed, in the first of the Income Tax Acts, that of 1842 (5 & 6 Vict. c. 35), provision was made for exempting from income-tax certain premises of institutions existing for the promotion of education, literature, science and the fine arts. Again, in an Act of 1843 (6 & 7 Vict. c. 36), provisions were inserted entitling such institutions, under extremely strict conditions, to exemption in respect of local rates. Later, when corporation duty was, as a compensatory measure, first imposed under the Customs and Inland Revenue Act 1885 (48 & 49 Vict. c. 5) upon the yearly value, income or profits accruing from real and personal estate permanently vested in bodies, corporate and unincorporate, which escapes liability to probate, legacy and succession duty, provision was again made for exempting such institutions from the duty in question. At the present day a scientific institution, as such, is entitled to exemption from income-tax under Schedule A (property tax) in respect of any building which is the property of such institution and is used solely for its own purposes. No payment may, however, be demanded or made for any instruction therein by lectures or otherwise, nor may the building be occupied by any officer or other person paying rent for the same (Income Tax Act, 1918, 8 & 9 Geo. V. c. 40).

A latent intention on the part of the legislature to benefit scientific institutions to some extent, great or small, is certainly present in the statutes referred to above, and at various times scientific institutions have endeavoured to avail themselves of the privileges in respect of exemption from taxation which seem to be offered to them. But how extremely difficult it is for such institutions to satisfy the Courts that their constitution and activities are of the character to qualify them to obtain the benefits which, to an ordinary layman, it seems that the legislature intended such institutions to enjoy, can be gathered from an examination of the cases in the Law Reports which relate to the claims for exemption from taxation made under the provisions of statutes particularly applying to them. It will be found that even on a particular set of facts, eminent judges have sometimes held opposing views in regard to the right to exemption.

Briefly stated, to obtain exemption from income-tax or corporation duty under the provisions of the abovementioned statutes, a scientific institution has to satisfy the Courts that the primary object of such institution is the promotion of science in the abstract; its property and income are legally appropriated by a Royal Charter or other compelling instrument and applied in fact to that object; and further, if the object of the professional interest of its members is to be inferred, this must at least be secondary to the main and chief object. In consequence of the foregoing state of affairs, the important partial exemptions from income-tax which accrue to scientific institutions, as a rule, are granted, not by reason of the provisions of the statutes conferring privileges specifically on such institutions, but under the provisions of taxing statutes containing an exemption in favour of property dedicated to 'charitable purposes,' an expression which in a legal sense has an extremely wide meaning and is applied to all trusts known to the law of England as 'charitable uses.'

The great value of the work done by the members of the leading scientific institutions has not been contested at any time. It is fully recognised that such institutions are great clearing-houses of specialised knowledge and that they greatly stimulate scientific research. In thus promoting the advance of science and the development of industries, scientific institutions confer considerable benefits, indirectly it is true, on the whole community, and it is desirable therefore that nothing shall be done which may restrict their usefulness. A strong case can really be made for giving the widest interpretation to the exempting clauses of statutes under which scientific bodies are at present entitled to enjoy remission from taxation; further, it is certain that the national exchequer would gain more from measures taken to secure this end than from the adoption of a course which may result in seriously cutting down existing privileges.

Rust-Resisting Steels.

Stainless Iron and Steel. By J. H. G. Monypenny. Pp. ix + 304 + 22 plates. (London: Chapman and Hall, Ltd., 1926.) 21*s.* net.

THE loss to our civilisation through the rapid attack by atmospheric and marine influences upon the iron and steel upon which it is really based has been estimated by Sir Robert Hadfield to reach the large sum of 500,000,000*l.* per annum. There is no need to criticise such an estimate, since obviously the computation is necessarily only achieved by empirical methods. The fact, however, is that there has been probably no more useful field for pure and applied science than that provided by the problem of producing rust-resisting steels.

It may be said that two decades ago the metallurgical world did not seriously contemplate the production of rustless steel as likely to be an early practical achievement; not because investigators were not giving much attention to the subject, but rather because of the curious misapprehension concerning the nature of the laboratory tests that were likely to give indication of resistance to atmospheric attack. This, of course, means that there was no accurate appreciation of the true mechanism of corrosion. For example, the literature teems with experiments upon the degree of resistance of iron and steels of diverse composition to sulphuric and hydrochloric acids of different concentrations. These acids attack the metal with the liberation of hydrogen. Such acids are not usually prevalent under natural conditions, and the rustless steels now produced which resist ordinary corrosion are not passive to the acids mentioned.

Mr. Monypenny is to be congratulated upon having produced a book of merit, in which will be found a reasonably full and accurate account of the composition and characteristics of the rustless steels which are now available. The development of these steels has been particularly rapid, and is based, fundamentally, upon the alloying of the metal chromium with the steel. If experimental samples are prepared from a range of steels of low carbon content, but with gradually increasing chromium content, and are placed in nitric acid of spec. grav. 1·20, it will be found that when a chromium content of 10 per cent. is passed, almost complete passivity is attained. The phenomenon can be, at present, satisfactorily explained by the assumption that a protective film of the desired characteristics is immediately formed on the surface of the specimen, which inhibits further action. Such explanation is completely in accord with experimental facts to date. Laboratory tests with nitric acid appear to be indicative of resistance to ordinary atmospheric effects. If, however, the range of corroding media is extended, such a simple form of test fails, and hence the practical extension of the employment of such steels to a wider range of corroding media has necessitated practical experiment under the necessarily complex actual service conditions, coupled with the gradual modification in the composition of the steel to meet those conditions. The development has taken the direction of increasingly high chromium content together with the addition of nickel. It is also claimed that other elements can be advantageously added.

If the steelmaker is to use the metal chromium in quantity, he is dependent upon his supplies of the metal, which is usually in the form of the alloy ferro-chromium. Until comparatively recently, the supplies of ferro-chromium available were very high in carbon content, but the rapid development in the metallurgy of chromium reduction has now rendered available rich alloys of chromium and iron of suitably low carbon content. These developments are made possible by the use of suitable electric furnaces and cheap power. When it is also recorded that the rustless steels are best prepared in electric steel-making furnaces, it will be realised that here, as in many other developments, the actual application of the discoveries has been dependent upon parallel progress in entirely dissimilar fields of investigation and technology.

Turning to Mr. Monypenny's book, it will be found that after a short historical account of the development of the steels, the results of a detailed study of the influence of chromium are given. The succeeding sections of the book are devoted to practical notes on the handling of the steels in various manufacturing operations, such as forging, welding, pickling; the effects of heat treatment on the mechanical and physical characteristics; and the "resistance to corrosion" as affected by composition and treatment. So far, the book, generally speaking, deals with the simple carbon chromium steels. The next section deals with the newer types of rustless steel. The principal item in this connexion is the 'austenitic' type of material obtained with the increased chromium content together with a substantial addition of nickel. The final section of the book indicates various applications in which these steels have been found successful and, incidentally, gives practical notes and hints, which should be of considerable value to intending users.

Generally speaking, the matter dealt with is clearly and logically arranged, and the reader should find little difficulty in obtaining the information he desires concerning the main characteristics of the materials, and in following the main arguments. The work is, naturally, not of the reference type where the answer to a particular problem can be readily obtained, but

rather one for the student, who, by relating the various facts represented, can find out for himself the answer to many of his problems. The book will be welcomed as covering a field which is so comparatively new that adequate treatment has not previously been given to it.

There are a few points where the author's handling of the subject is open to criticism. Much of his data for typical stainless steels is obtained on alloys containing 11 to 12 per cent. of chromium, whereas practice has established the best range as being between 12 and 14 per cent. On p. 46, in dealing with heterogeneity, the statement is made that after freezing, diffusion of carbon rapidly takes place. This is only relatively true, and, in any case, only applies to diffusion on a microscopic scale. In a mass of moderate size, diffusion of the carbon is very slow indeed.

The deduction made by the author in Chap. v., that sulphur, when present in stainless steels, "obviously is not present in the same form as in ordinary steels," will require experimental proof. On p. 103 the value of maximum stress in torsion for a sample of 55 tons tensile stainless material is apparently the value deduced on the assumption that the torque at this stage gives a distribution of a stress similar to that when the strain is entirely elastic. The real value of maximum shear stress is probably much less than this.

With regard to the author's treatment of the influence of other elements than the essential chromium and nickel on the characteristics of these steels, we have an impression that the deductions are a little hastily formed on perhaps too little experimental data. This is best instanced in the case of the influence of silicon. The author's comments concerning the influence of this element are not in accord with the fact that a very considerable tonnage of stainless steel is used with a silicon content round about 1·0 per cent., and had the author more thoroughly explored this particular field, both as regards the composition of his samples and the variation in the hardening and tempering temperatures, he would not have been led to the conclusion that silicon so readily induces brittleness.

In discussing the non-production of very high tensile stainless steel-drawn wire, the reason given by the author on p. 138 does not appear adequate. The 'hardening-up' effect should help rather than hinder the production of high tensile properties. The present writer considers the difficulties in the way of such operations are due to other causes.

More data are obviously needed on the austenitic chromium-nickel steels, and in this respect the special adaptability of such materials for many purposes might have been emphasised to a greater extent. The superiority of such materials, from the point of view of corrosion, over the stainless steels, is so pronounced as to constitute an advance in the problem of resisting corrosion only comparable with the initial introduction of the chromium steels.

Mr. Monypenny is to be congratulated upon the production of an excellent work. The book is handsomely produced, and the reproductions of the photographs and microstructures are a credit to both the author and the publishers.

Nature-Gods.

The Worship of Nature. By Sir James George Frazer. Volume 1. Pp. xxvi+672. (London: Macmillan and Co., Ltd., 1926.) 25*s*. net.

THIS volume contains the author's twenty Gifford lectures for 1924 and 1925, expanded and regrouped into sixteen chapters dealing with the worship of the sky, the earth, and the sun. It is to be followed by another which is designed "to complete the survey of the worship of the sun, and to deal with the personification and worship of other aspects of nature, both inanimate and animate," or, as the publishers' announcement has it, "the worship of the Moon, the Stars, Fire, Water, Wind, Plants, and Animals." The "Worship of Nature" is thus the counterpart of the author's last previous compilation, "The Belief in Immortality and the Worship of the Dead"; and in the present "Introduction" (p. 17) he indicates his belief that if "we survey the natural religion of primitive peoples in all parts of the world, we shall probably discover that it everywhere assumes one of two forms which, far from being incompatible with each other, are usually found to be embraced simultaneously and with equal confidence by the worshippers. One of them is the worship of nature, the other is the worship of the dead."

This survey of the "natural religion of primitive peoples in all parts of the world" Sir James Frazer has not achieved yet. In his three volumes on the "Belief in Immortality and the Worship of the Dead," he dealt only with Micronesians, Polynesians and the natives of Australia, the Torres Straits Islands, New Guinea, and Melanesia, and then stopped. In examining the "Worship of Nature" he has selected as arbitrarily; taking in turn, for the worship of the sky, the 'Aryan' and the non-Aryan peoples of antiquity (with the curious omission of Celts and Teutons), the 'civilised' peoples of the Far East (omitting among others the Japanese); then Africa (in four main sections), and nothing more. For the worship of the earth the specimen peoples are similar but not identical; Vedic Indians, ancient Greeks, Romans, Babylonians and Assyrians, Egyptians, Chinese, peoples of modern India, Africa, and America; and for the sun (in this volume), the same, with the omission of China, Africa and America,

and the inclusion of the Arabs, Japanese, and Indonesians.

Reasons for selecting these peoples are not given, except that by contrast with the procedure adopted in Pettazoni's "L' Essere celeste nelle credenze dei populi primitivi" (Rome, 1922), the "superior antiquity of the documents" about Aryan beliefs, and the "higher interest" of them, are regarded as justification for treating these beliefs first. Consequently, the separate chapters stand in no organic connexion with each other; there is no attempt made to compare their contents, or to draw any general conclusions. Even on the connexion between the sky-gods of various Aryan peoples there are only the briefest observations (p. 36), and on the significance of Ahura Mazda the compiler is "content to record the two views without attempting either to judge or to reconcile them" (p. 35). From the author of "The Golden Bough" this is disappointing.

Within the separate topics, the method is that adopted in "The Belief in Immortality": to select the most trustworthy authority, and summarise the principal statements in more or less systematic order; but what the system is, we are left to judge for ourselves. But whereas in Micronesia, for example, this method is so far justified that there is usually only one authoritative record for each people, or at most the observations of two or three observers, its application to peoples who have been so carefully and repeatedly studied as the Aryan peoples of antiquity has an appearance of economy of effort. The chapter on the worship of earth in China, for example, is almost wholly extracted from Chavannes' "Les T'ai Chan" (Paris, 1910); in Babylonia, from King's "History of Sumer and Akkad"; in Egypt, from Wiedemann and Erman; and on the worship of the sun in Japan, from Aston's "Shinto, the Way of the Gods." The result is very readable, diverting in its frequent long episodes quoted verbatim, its eloquent verbal landscape-painting, and its sardonic and sometimes broad humour at the expense of the more ingenuous "devices of the heathen"; but it does not advance learning greatly. In the work of a beginner it would run the risk of being described as the method of "scissors and paste"; in that of a veteran, we naturally look for another explanation. But Sir James Frazer does not help us. Is he insinuating that there is nothing more to say, except that this and that people may be accepted as worshippers of the sky, earth, sun, and the like; or is he speaking to us in parables, and reserving his own conclusions for yet another volume? The lame conclusion of "The Belief in Immortality" (p. 326) favours the former inference: "accordingly, we are justified in concluding that the belief in immortality and the worship of the dead were fundamental features of the ancient Micronesian religion," as if it were possible in any intelligible sense to speak of "the" ancient Micronesian religion, any more than of "the" ancient Micronesian race.

Occasionally, however, something rather more positive is foreshadowed. Summing up an account of the Shilluk and Lango chief-gods, whose name *jok* or *juok* means in the Dinka language "the spirit of a dead ancestor," Sir James Frazer is at some pains to contest the obvious inference, on the strength of "the analogy of African sky-gods or Supreme Beings in general," who, for the most part, he thinks, "are sharply distinguished from the ancestral spirits not only in name but in function"; and so, in spite of the embarrassing *jok*, he concludes that "so far as they go, these facts support the view that African sky-gods or Supreme Beings in general are not deified ancestors, but simply personifications of the great celestial phenomena, whether the sky, or the rain, or the sun"; a thesis which we should like to hear him defend before a jury of *jok*-ists.

From this and a few similar hints, it looks as if Sir James Frazer's contribution to the "natural theology" which the Gifford lectures were founded to elucidate may turn out to be a "spiritualistic hypothesis," as he calls it in his introduction (p. 10), which "has undergone a process of simplification and unification analogous to that undergone by the materialistic theory: as the materialistic hypothesis has reduced the multitudinous forms of matter to one substance, hydrogen, so the spiritualistic hypothesis has reduced the multitude of spirits to one God." But it is not quite clear how far the copious information collected in this volume is intended to take us in the verification of this hypothesis. Sky-gods, and earth-gods, and sun-gods, are about as much like the "one God" of the spiritualistic hypothesis as hydrogen is to the "one substance" of the materialist. All that emerges from this first volume of Sir James Frazer's new book is the rather cautious generalisation that some people worship some nature-gods. But perhaps the second volume may go further.

The Periodicity of Earthquakes.

Die Frage der Periodizität der Erdbeben: eine Darstellung des gegenwärtigen Standes der einschlägigen Untersuchungen. Von Prof. Dr. Ernest Tams. (Sammlung geophysikalischer Schriften, No. 5.) Pp. ix + 128. (Berlin: Gebrüder Borntraeger, 1926.) 9·60 gold marks.

OF those who have studied earthquakes, few have escaped the lure of earthquake statistics, or failed to attempt the detection of some influence, external to the earth, in determining, or at least

influencing, the time of occurrence. For some it has been an introduction to seismology, to some also the end of their activity in this field, to others merely an incident in a wider treatment of the subject, but sooner or later the call comes to all, and is always fraught with danger. Figures have a fascination which may be fatal; once involved in them the temptation is great to try them in one way after another until some definite conclusion seems to have been reached. The literature of the science contains many examples of such misdirected labour, often simply useless, sometimes misleading, much of which would have been avoided had those who knew their earthquakes been also acquainted with the principles of statistical investigation, or those who were familiar with mathematics understood the character of the data with which they dealt.

To the latter class the book under review makes small appeal; to the former it will be useful. Of the two parts into which it is divided, the first is devoted to a description of the methods which are used in computation; the regular method of harmonic analysis is described in sufficient detail, as also is the approximate method of overlapping means, elaborated by Dr. Davison, and in both cases examples of working are given. The author decides in favour of the latter, for ordinary use, as giving similar results to the former, with sufficient accuracy and with a much less laborious computation; but he does not seem to be acquainted with a simpler method of analysis than that described, which takes no longer, and uses no more paper, than the Davison method, besides having the advantage of giving a result in the form conventionally adopted, and with greater precision, though with not greater real accuracy. This last mentioned has, however, on its part, an advantage, in that the computation proves itself at every stage, and mistakes can be detected immediately, whereas in the other method the only proof possible is a repetition of the entire calculation, from beginning to end. Finally, a section of this part of the book is devoted to the consideration of variations in frequency due to causes which are not periodic in their recurrence.

As a whole, the treatment is satisfactory and adequate, but there are two points which do not seem to be sufficiently emphasised. The first, and it is one which it is important to impress on those to whom the work is addressed, is that while a given periodicity may be expressed as the sum of a series of harmonic periods, harmonic analysis does not assert that it must be interpreted as the result of such combination; in other words, the method can only be properly applied where the cause of the effect looked for is one that acts in a manner which makes the method applicable. The other point not dealt with, though even more important, is that where the record is so imperfect, and the data so unprecise, as in any non-instrumental record of earthquakes, it is essential to deal with averages of a large number of shocks. A somewhat extensive experience has shown the reviewer that the lower limit of this number must be put at about 400 times the number of separate groups into which the series has to be divided for the purpose of discussion. If the effect to be investigated needs a division into only two groups, then a record covering 800 shocks may suffice, but for anything analogous to a harmonic analysis, at least four times this number are required; needless to say, the more the number exceeds these limits the better, so long as the record is homogeneous for the purpose in view, but smaller numbers will give irregular and contradictory results.

The second part of the book is devoted to a consideration of the different periods, correlated with the solar or lunar day, month, year, or longer periods, and the non-periodic variations which have been correlated with variations in barometric pressure, rainfall, shifting of the poles, and so on. The treatment is rational and sufficient, and the conclusion come to by the author may be fully accepted, that though, in several cases, it has been shown that the cause investigated may possibly have some small effect in determining the time of occurrence of an earthquake, the connexion has not been established in any single instance.

The conclusion might have been strengthened had some recently published papers reached the author, by which doubt is cast on the reality of some periods which might naturally be expected to exist. Prof. H. H. Turner has suggested that the so-called annual period is not really annual, but differs from the exact year by about ten hours, so that the epoch of maximum frequency works round the calendar in about 850 years; and the Italian record, by far the most accurate and complete of any that is available, indicates that the maximum frequency, of the well-marked diurnal period, has advanced steadily through the thirty years which have been tabulated, at the rate of about five minutes a year. If these small differences are real, what is the meaning of the periods of about ten hours less than twelve complete months, or about three-quarters of a second more than twenty-four hours, respectively? They cannot be correlated directly with the revolution of the earth on its own axis, or round the sun, and they throw doubt on the exactitude of other periods which are supposed to have been detected. Everything is in doubt; we have no proof, or even reasonable probability, of the existence of any periodicity, and those who think that they have time to spare for the pursuit may find justification for an attempt to succeed where others have failed.

Among the variations in frequency which might be attributed to influences external to the earth, the one which shows the nearest approach to probability is the slightly greater frequency of shocks during the day, and the correspondingly lesser frequency at night, in summer as compared with winter. As this has been found to hold good for every suitable record which has been tested, and as it also holds good, with the necessary change in nomenclature, for lunar times and seasons, it may be accepted as a fairly well established fact. Seeing that it is also just such a variation as might be expected, if the gravitational stresses, set up by the sun and moon, had some effect in determining the time of occurrence of an earthquake, the two may reasonably be correlated as cause and effect. But if—and the reservation is an important one—this conclusion is correct, then the smallness of the effect shows how trivial is the influence of the cause, and how predominatingly the earthquake is a phenomenon of the earth, earthly.

Sir Walter Raleigh.

The Letters of Sir Walter Raleigh (1879–1922). Edited by Lady Raleigh. Vol. 1. Pp. xxix + 272 + 4 plates. Vol. 2. Pp. xv + 273-579 + 5 plates. (London: Methuen and Co., Ltd., 1926.) 30*s*. net.

IN this selection from his private letters we have a portrait drawn by his own hand of the late Sir Walter Raleigh, well known in academic circles as a distinguished critic and man of letters, and among his intimate friends as one of the most engaging and delightful companions. To have read Raleigh's books was not enough. He had a side not to be found there, in some ways still more interesting and attractive. Admirable as his writings were, many of his acquaintances prized them less highly than his conversations, when he was wholly himself, less weighted with a sense of responsibility, and accustomed to give a free and joyous vein to his whimsical humour. For Raleigh's social gifts were such that, though he preferred light to serious subjects, his hearers were too content with the fare he provided to ask for any other. So delicate was its flavour that his brand of nonsense was, for so long as he cared to distribute it, better than any sense. Nor was this surprising, for it was a nonsense sparkling with intelligence, and far removed from that 'silliness' which he disliked in man and books. It was his way to approach truth by way of humour, and to judge even of his own writings by the standard of good sense, the standard of things able to survive all humorous assaults upon them, as when he said of his "Shakespeare," "I don't want to write anything that William himself would have thought rot."

These volumes are, in Raleigh's case, a supplement, and an important supplement, to his public utterances. If they are less carefully considered, they are, because more spontaneous and instructive, a better index to his mind and character. His letters cannot replace, indeed, the charm of his conversation, but they recall it, and preserve some quality or relish of it for those who had never the fortune to hear his living voice. He enjoyed talking on paper to his friends, as he enjoyed talking to them in person, and in these letters he is speaking rather than writing. There are wines that will not bear bottling or exportation, and often the qualities in a man adjudged the most attractive by his contemporaries are either wholly hidden from succeeding generations, or but dimly guessed at. Certainly the future, which can only judge of Raleigh by his books, will miss something of the singular pleasantness that informed his daily speech. The letters cover a wide range of topics, from his early experiences as a professor in Aligarh to the late War; too wide to be illustrated by quotation, but certainly not the least interesting, are those written soon after he left Cambridge, "the place of my early friendships, dreams and idleness," which reflect the impressions of the scenery and society of the East upon a mind quick to receive and eager to record them.

Raleigh's interests, it may with truth be said, were human rather than bookish; for a professor and writer, indeed, unusually remote from the study. He would rather, he said, "have missed Cambridge than India"; and was never quite convinced of the value either of lectures or examinations. Academic machinery creaked rather dismally in his ears. The play of life as it passed before his observant eye had a fascination for him beyond anything that the poets or historians had to say of it, a fascination that into words no virtue could digest Life, he felt, needed no assistance from the artist to give it either interest or significance.

Raleigh emphatically placed living above art or science, and had more sympathy with men and their doings than with the makers of books about either. For this reason his most passionate admiration went out to adventurers, and more especially to young adventurers, the high-spirited soldiers, or voyagers or airmen, rather than to those who recorded or sang of their exploits. That his life should have in the end been sacrificed to his enthusiasm for, and determination to do justice to, the pioneers of flying is a sufficiently convincing proof of his preferences, and it was characteristic of him that as an Oxford professor, past middle life, he drilled and marched and did what he could to make himself a soldier. "The last three days I've been marching and lying out on the Downs in torrents of rain, and housed in billets. Billets is 60

beds for every 100 soldiers. . . . Weather disregarded. You have to get through barbed wire like a knife, and tear your clothes much or little."

Sir Walter's friends owe a debt of gratitude to Lady Raleigh for these volumes, and to Mr. Nichol Smith for his brief but admirable memoir of their author, for they will recall many delightful hours in his company. In all their readers they cannot but arouse regret that so rare a spirit has passed beyond the term of human acquaintanceship.

Our Bookshelf.

The Petrology of the Igneous Rocks. By Dr. F. H. Hatch. Eighth edition, revised with the assistance of Dr. A. K. Wells. Pp. xxiv + 566. (London: George Allen and Unwin, Ltd.; New York: The Macmillan Co., 1926.) 15s. net.

WITH the collaboration of Dr. A. K. Wells, this well-known text-book has been revised and extended until now it is virtually a new book. Among the new features are chapters dealing with the consolidation of magmas; the classification of igneous rocks; changes in composition subsequent to consolidation (including pneumatolytic, hydrothermal and other phases of metamorphism as well as weathering); petrographic provinces; and cycles of igneous activity in the British Isles.

Dr. Hatch was a member of the Committee on British Petrographic Nomenclature (1920), and he has naturally adhered to most of the decisions then reached. A welcome simplification of the unwieldy nomenclature of the subject has been achieved, but unnecessary confusion has been introduced by adopting first a classification of types into *acid*, *intermediate* and *basic* divisions, and then a subdivision of some of the groups, such as the syenite group, into *oversaturated*, *saturated* and *undersaturated* divisions. The term 'acid' is sometimes used to mean that a rock is oversaturated, and sometimes to imply a silica percentage not less than 66. It is a pity that the older terms were not altogether dropped. On p. 186 the terms *salic* and *femic* are wrongly used for *felsic* and *mafic* respectively. A useful suggestion due to Prof. Watts has been adopted: the naming of a rock according to its texture with the qualifiers 'intrusive' or 'extrusive' added where necessary. Thus one may have an *intrusive basalt* or an *extrusive dolerite*, and a common source of futile indecision among students is thereby removed, in the only logical way.

The book is now thoroughly up-to-date. It contains abundant references to the splendid work carried out at the Geophysical Laboratory at Washington. Heteromorphous rocks are discussed, eclogite being recognised as a heteromorphous phase of gabbro. The work of Dr. Brammall and Dr. Harwood on the minerals of the Dartmoor granite is included, and the book may be said to present a very complete and well-balanced survey of the subject up to the end of 1925. Controversial and speculative matters are wisely given little space, and students using the book may rely upon it as a sound and authoritative exposition of a delightful subject.

Applied Chemistry: a Practical Handbook for Students of Household Science and Public Health. By Prof. C. Kenneth Tinkler and Helen Masters. Vol. 2: *Foods.* Pp. xi + 276 + 3 plates. (London: Crosby Lockwood and Son, 1925.) 15s. net.

THIS book deals with certain branches of the chemistry of foods which have particular interest to students working for the B.Sc. (Household and Social Science) degree of the University of London. It forms a companion volume to that produced by the same authors in 1920 on water, detergents, textiles, fuels, etc. The general treatment is elementary, but the authors have adopted the policy of giving references to standard works wherever possible. In addition to such subjects as milk, edible oils, foods their analysis and calorific value, raising agents, vinegar and preservatives (subjects which are found generally in food analysis books), a separate chapter on the cooking of foods is included. In introducing this somewhat novel subject in an elementary text-book, it is explained that this operation is still primarily an art and not a science, and that our knowledge of the chemistry and physical changes which take place in the preparation and cooking of foods is at present very meagre. Nevertheless, the authors in some thirty-five pages have collected a large amount of scientific data on cooking foods and on the use of condiments, and have given an exceptionally good exposition of the subject.

In many cases interesting chemical determinations bearing directly on food analysis, etc., have been considerably restricted for want of space, yet the determination of specific gravity, specific rotatory (spelt rotatary) power, calorific value, and hydrogen ion concentration—subjects usually well treated in practical physico-chemical text-books—receive a comparatively large amount of attention. The book is well produced with clear diagrams, and the price reasonable judging by present-day standards.

J. REILLY.

Éléments d'astrophysique: introduction à l'étude de l'énergétique solaire et stellaire. Par Dr. Albert Nodon. Pp. viii + 244. (Paris: Albert Blanchard, 1926.) 20 francs.

THE author has produced a useful book of reference based on his public lectures delivered at Bordeaux. The contents are divided into two parts. Part 1 contains some seventy paragraphs, in which are outlined the recent advances in astrophysics made possible by well-known theoretical and practical investigators. Part 2 includes tables of notation, physical constants, explanatory notes, and bibliography arranged with reference numbers so as to amplify the paragraphs of Part 1. Although the book is intended, presumably, for general scientific reading, the arrangement of the subjects will scarcely commend itself to the beginner. Commencing with an account of modern ideas on the structure of the atom and the phenomena of radiation, the author then passes to such matters as the opacity of stellar atmospheres and radiation pressure. Paragraphs dealing with the sun follow those on stellar spectra, giant and dwarf stars, etc.

Many of the illustrations receive no explanation in the text, and a knowledge of instrumental equipment assumed. We consider that the lack of detail in

some of the résumés detracts considerably from their value. No explanation is given, for example, of St. John's schematic section of a sunspot, reproduced on p. 100, neither is any reference to be found to the work of Evershed, A. Fowler, and Maunder on sunspots and their spectra. The usefulness of Part 2 would have been increased by fuller explanation or wider bibliography on matters (such as the distances and numbers of the spiral nebulæ) where conclusions are not yet generally accepted.

The Making of the Future. The Coal Crisis and the Future: a Study of Social Disorders and their Treatment. By P. Abercrombie, V. Branford, C. Desch, P. Geddes, C. W. Saleeby, and E. Kilburn Scott. Pp. xi + 111 + xlvi. (London: Leplay House Press; Williams and Norgate, Ltd., 1926.) 8*s.* 6*d.*; paper, 6*s.*

In this volume the coal problem is attacked from various angles by the several contributors, though a certain coherency is obtained, since most of the writers would appear to subscribe to the viewpoint of the 'sociologist.' The quality is, however, somewhat uneven, and it is to be feared that many readers will become impatient of the terminology and verboseness of certain of the writers. About one-half of the volume is devoted to an account of the "Conditions of Eutopian Repair and Reconstruction." This, though it may interest some readers, would have been improved by compression, as it is somewhat vague and at times irrelevant. The appendices do not appear to bear very directly on the problems of the coal industry. Several of the papers, however, are more concise and contain some interesting matter. Prof. Desch and Mr. Kilburn Scott contribute readable articles on the technical aspects of coal utilisation; Dr. Saleeby pleads on hygienic grounds for the elimination of the smoke nuisance, while Prof. Abercrombie describes the planning of the Kent coal-field on the basis of regional surveys.

Handbuch der Pflanzenanatomie. Herausgegeben von Prof. K. Linsbauer. Lief. 13 (II., 2B.; Bg. 1-4). 2 Abteilung, 2 Teil: *Pteridophyten und Anthophyten.* Band IX. 2: *Die Vegetationsorgane der Anthophyten. Organe besonderer physiologischer Dignität.* A: *Die Absorptionsorgane der parasitischen Samenpflanzen.* Von Prof. Dr. Adolf Sperlich. Pp. iv + 52. (Berlin: Gebrüder Borntraeger, 1925.) 4·50 gold marks.

THE section of this handbook of plant anatomy at present under notice discusses briefly the ascertained facts as to the haustoria of the parasitic or semi-parasitic flowering plants. Dr. Sperlich divides them into three groups: he gives most space to the haustoria of (1) the Rhinantheæ, Orobanchaceæ, and Balanophoraceæ, and (2) the less parasitic Santalaceæ, Loranthaceæ, and Olacaceæ, with which group he includes the wholly parasitic Rafflesiaceæ. He puts in a special section, but discusses very briefly, the more root-like but still morphologically distinctive organ, the haustorium of Cuscuta. Curiously enough, with reference to recent papers recently referred to in NATURE of February 6, p. 210, and subsequent correspondence (NATURE, March 27, p. 452), no citation is given of the paper by Mrs. Thoday (Sykes) upon Cuscuta, and the question of the possible presence and function of the phloem in the haustorium is not touched upon.

Les fleurs de la Côte d'Azur (De Toulon à Menton). Par Léon Marret. (Encyclopédie pratique du naturaliste, 21.) Pp. 428 + 112 planches. (Paris: Paul Lechevalier, 1926.) 40 francs.

THIS flora, which is well illustrated with text figures and some coloured plates, will be found of great service to botanists and plant lovers visiting the Riviera. It is divided into four main sections. In the first portion the native wild vegetation is described and figures are given of the more important wild plants of the region. The second portion is devoted to "Les Cultures ornementales"; that is, the introduced plants to be found in the gardens and parks of the Côte d'Azur. In the third part the industrial plants are dealt with; and finally a large section is devoted to "Les Cultures alimentaires." In the first portion the plants are referred to under their ecological formations, those of the sand dunes, maquis, garrigues, rocky situations, marshes and meadows, and mountains, and much interesting and useful information is given. The illustrations are scattered throughout the volume, and the reader may find it a little difficult to identify any particular plant or to find his way easily about the book. It is, however, a very useful volume and worthy of careful study by any one interested in the rich native and exotic vegetation of the Riviera.

Combustion in the Power Plant: a Coal Burner's Manual. By Thomas A. Marsh. Second printing, corrected. Pp. xi + 255. (London, Bombay and Sydney: Constable and Co., Ltd., 1926.) 12*s.* net.

As the title indicates, this book deals with the author's experience in the operation of steam boilers in central power plants, and in the main with American plants. Thus much of the contents has little direct bearing on conditions elsewhere. Twenty-five per cent. of the space is devoted to describing the coals of the United States and their behaviour in boiler furnaces.

The discussion of the relative suitability of the various patterns of stoker to different fuels does contain information of general application, and the author's experience of this and other problems of steam-raising on the large scale will be useful to boiler-house operators. They will also be entertained, for this is no dignified scientific treatise, and the writer never disdains enforcing an argument by means of an anecdote. H. J. H.

Le radium: découverte de la radioactivité et du radium, origine de l'énergie radioactive, le radium dans la nature, ses emplois usuels. Par F. Honoré. Pp. viii + 145. (Paris: Gauthier-Villars et Cie, 1925.) 18 francs.

M. HONORÉ is a member of the staff of *L'Illustration*, and his book is virtually an enlarged edition of a series of articles which he contributed to that journal. It therefore gives an attractive and popular account of the discovery, manufacture, properties and applications of radium and associated substances, which should appeal to educated members of the general public. Strangely enough, the artificial disintegration of elements by means of α-rays does not appear to be mentioned in this book.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Disposal of Scientific Journals.

THE "Universities' Library for Central Europe" was established towards the end of 1920 in order to co-ordinate and consolidate the securing by gifts, exchange and purchase, British books, journals, etc., for students, teachers and libraries in the universities of Central Europe. The last year or two has seen a change in the character of our work owing to the fact that the urgency for the distinctly charitable aspect of it has somewhat relaxed, and our task, while less serious from this point of view, in other directions has been considerably extended.

We have administered the book-funds of various universities and institutions in Austria, Czechoslovakia, Finland, Germany, Hungary, Poland and Rumania, established small select libraries in six different places abroad, on the subject of international problems, for the use of discussion groups of university students, and at the request of the Under-Secretary of State at the Foreign Office, have assisted the Parish Public Library at Malines, Belgium, with works of English literature. We have also arranged for regular and direct exchange of publications between Russian scientific institutions on one hand and similar institutions in Great Britain, India and Egypt on the other. Acting in conjunction with the League of Nations Committee on Intellectual Co-operation, we have undertaken to accept literature from other European countries for distribution anywhere in the United Kingdom, and similarly, the Universities' Library distributes all over Central Europe books and periodicals received from universities and learned societies in Great Britain.

In response to a suggestion made by the Editor of NATURE arising out of recent correspondence in the columns of this journal, the Committee has agreed to provide within the Society, a clearing-house for the reception and distribution of scientific books and periodicals from and between individuals and institutions in Great Britain. It is apparent that there are many persons and libraries which at times have to dispose of files of periodicals and other surplus works owing to the exigencies of space. This material often has no great market value, and yet no lover of his subject cares to destroy or sell it as waste paper. Even the indiscriminate giving of this literature does not always result in its most advantageous placing, and undoubtedly the systematic collection and distribution of such books and periodicals is a matter of national importance.

The organisation for such a work already exists, as will be seen, in the above Society, but such an addition to its activities will naturally entail some increase of expenditure; this may not be much more than the cost of packing and transport, but even so, the existing very limited funds of the Society are earmarked for its Continental work, and it will be readily appreciated that this Society must depend upon donations in order to enable it to carry out this further extension of its activities. It is therefore with confidence that we appeal to all readers of NATURE to contribute a small sum to enable this work to be fully developed. Any gift, however small, will be gratefully acknowledged. Any person or institution having surplus scientific literature which it is desired to place in a suitable library or other institution in the United Kingdom, is invited to communicate with me at this address.

B. M. HEADICAR,
Hon. Secretary.
Universities' Library for Central Europe,
London School of Economics,
Houghton Street, London, W.C.2, June 18.

New Facts regarding the Phases of Migratory Locusts.

THE work on *Locusta migratoria* L., which was published in Russia 1912-14, has been regarded by most entomologists as throwing an important new light on the origin of locust swarms. According to the Russian entomologists, two species, *Locusta migratoria* L. and *Locusta danica* L., are to be regarded as forms of the same species, differing in habits, yet intimately related, in that the two forms may emerge from the same egg-mass, occur in the same hopper swarms, and, as was demonstrated by laboratory experiments, can, by suitably altering the conditions, be changed from one form to the other.

Generalising from the observations of these workers and from the examination of a wide range of examples of migratory locusts from various countries, Uvarov (*Bull. Ent. Res.*, vol. 12, pp. 135-163, 1921) formulated the Phase Theory of the Periodicity and Migration of locusts, according to which periodical swarms are dependent for their inception upon the accelerated breeding of other non-migratory and closely related forms, which persist over a wide range in those countries subject to invasion by swarms. These two forms were named by Uvarov 'phases,' in the case of the South Russian species, the solitary locust being the *danica* phase, and the swarming the *migratoria* phase.

Working about the same time in South Africa on *Locustana pardalina* (Walk.), Faure (*Jour. Dept. Agric.*, Union S. Africa, Sept. 1923) has shown that this locust possesses these two phases, and that the solitary phase, which mingles with the swarms of migratory locusts, is also the locust which occurs on the veldt singly and in small loose swarms during the off-season of the migratory phase.

Another important locust of the Old World is *Schistocerca gregaria* Forsk. (= *S. peregrina* Oliv.), which ranges from India to N. Africa, and occurs as a major pest in some years in the Sudan.

As the result of certain recent observations made by the writer, it is claimed that this locust also comes within the terms of the Phase Theory, in that another species of the same genus (*S. flaviventris* Burm.) has now been ascertained to be the solitary phase of *S. gregaria*.

The opportunity for proving the existence of this relationship, which had already been suspected, was met with when, following the abnormally heavy rains in December 1925, *S. flaviventris* gave evidence of great breeding activity on the Red Sea coast north of Port Sudan early in the present year.

During the previous summer, *flaviventris* locusts could be found singly in this district. After the rains these were attracted to the beds of the watercourses which flow intermittently from the hills on the west towards the Red Sea. Here breeding went on undisturbed for some three months, probably three broods at least being produced, until by March adult locusts very strongly approaching the migratory locust in structure and external appearance were found in large numbers.

The threatened destruction of certain grain and cotton crops compelled the adoption of control measures. Following this, the incipient *gregaria* phase was thrown back to the *flaviventris* phase. This result was due apparently to the thinning out of the hopper swarms by the vigorous use of poison bait.

It is not proposed to draw too sweeping conclusions from these facts, since it is realised that much further work is needed before their true significance can be demonstrated. It is claimed, however, that the following additions to our knowledge have been made; namely, the working out of the main facts of the life-history of the *flaviventris* locust in the Sudan, the observation of the habits of the larval stages of both phases in the field and the proof by laboratory breeding tests, confirmed by field observations, of the convertibility of the solitary hopper into the swarming hopper by the overcrowding of individuals in breeding cages. The reverse process has also been tested with success, namely, the transformation of the black-marked swarming hopper into the green solitary hopper by the segregation of single individuals of the former in breeding cages. These experiments were based on the work of Plotnikov in Russia on *L. migratoria*.

In this connexion it was observed that after the treatment of any area with poison and the resultant destruction of a large proportion of the swarming hoppers, the remaining hoppers, which owing to moulting being in progress or for other reasons had missed the bait, invariably tended to assume the colour of the solitary hopper.

It is believed that in the case of this outbreak on the Red Sea coast, a migration of *gregaria* locusts did not take place. Whereas in March these were plentiful and breeding in the beds of watercourses, in May *flaviventris* adults alone could be found. The last brood, on attaining the winged state, dispersed into the surrounding country, there to assume their solitary life until next winter.

As regards the practical significance of these facts, it is perhaps not too much to assume that should they be found applicable to other regions in the Sudan, the basis for working out a practicable method for the control of the *gregaria* phase may be in sight, since by the early thinning out of the solitary phase in its breeding haunts, the production of the swarming phase can be prevented.

H. BENNETT JOHNSTON.
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Khartoum, Sudan,
May 30.

Effect of Polarised Radiations on Animal Metabolism.

IN a previous note (NATURE, February 27, 1926) it was shown that *V. choleræ* and *B. typhosis* grow more rapidly in polarised light than in ordinary light of the same intensity. Further work on the same subject has been continued by us, and a paper embodying the results obtained on the growth of *B. coli* and *V. choleræ* has already been communicated to the *Indian Journal of Medical Research*.

The investigation has now been extended to higher animals, namely, rabbits and guinea-pigs, to see if the metabolic activity is accelerated by exposure to polarised radiations, as suggested by us in our previous note to NATURE as one of the possible explanations for the rise of temperature in the afternoon in the normal individual as well as in certain pathological conditions. The amount of carbon dioxide exhaled by the animals has been taken in these experiments as a measure of their metabolic activity.

Two female rabbits of about equal weight, pure white in colour, were put into two air-tight glass chambers of equal size with plane glass sides just big enough to accommodate the animals easily. Through a tightly fitting rubber cork fixed on the lid, two tubes were provided to serve as inlet and outlet for air. The outlet tube went right near the bottom of the chamber, while the inlet tube stopped short near the lid. Before entering the chambers the incoming air was made to pass through potassium hydroxide solution and a tower containing fused calcium chloride and soda-lime in order to free it completely from water vapour and carbon dioxide. The outgoing air from each chamber, after passing through two U-tubes containing pumice stone saturated with sulphuric acid, was bubbled through a strong solution of potassium hydroxide in potash bulbs with tubes of fused calcium chloride fixed at their ends, as ordinarily employed for accurate organic analysis, and then passed through tubes of baryta water to ensure that the whole of the carbon dioxide was being absorbed by the caustic potash.

The current of air through the system was maintained by means of a filter pump attached to a water-tap. The rate of current in the two systems, as indicated by the number of bubbles in the baryta tubes, was controlled and equalised by means of stop-cocks. Further confirmation of the equal amount of air passing through the two chambers was obtained by allowing atmospheric air to pass through each system, after disconnecting the device for intercepting carbon dioxide from the empty chamber, and weighing the increase in the two potash-bulbs due to the absorption of carbon dioxide. The animals were next put in the chambers, which were enclosed in the two partitions of a darkened wooden box, and control experiments were performed to measure the amount of carbon dioxide exhaled by the animals in the dark in half an hour. Before putting the animals in the chambers they were starved for six hours or more.

The chambers were lighted up with polarised and ordinary light of the same intensity by means of two tubes 7 cm. in diameter projecting from a wooden box containing a 100-watt metallum half-watt opal glass bulb. The lamp was rigidly fixed in front of one of the tubes, and the light in the other tube was obtained by reflection from a pile of plates inclined at the Brewsterian angle. The intensities of the polarised and the unpolarised beams were equalised by interposing blocks of glass placed vertically in the path of the beams until the radiant energy falling on a thermopile from the two sources produced equal deflexions in a sensitive galvanometer. The average polarisation as tested by Savart's polariscope (cf. Wood, "Physical Optics," p. 298, 1923 edition) was more than 90 per cent. For the sake of closer comparison results are given in ratios between the amounts of carbon dioxide exhaled by the two animals per kilogram of the body weight in a constant period of half an hour.

TABLE I.

Rabbit A exposed to polarised light.
Rabbit B exposed to unpolarised light.

Animal.	Weight.	Ratio in dark A/B.	Ratio in light A/B.	Ratio A/B in dark after exposure to light.
Rabbit A . Babbit B .	533 gm. 562 ,,	0·965 : 1	1·050 : 1	0·877 : 1

TABLE II.

Animals Interchanged.

Rabbit B exposed to polarised light.
Rabbit A exposed to unpolarised light.

Animal.	Weight.	Ratio in dark B/A.	Ratio in light B/A.	Ratio B/A in dark after exposure to light.
Rabbit B .	569 gm.	1·009 : 1	1·022 : 1	0·867 : 1
Rabbit A .	553 „			

Note.—The weight of both the rabbits increased during the course of the experiments.

TABLE III.

Guinea-pig A exposed to polarised light.
Guinea-pig B exposed to unpolarised light.

Animal.	Weight.	Ratio in dark A/B.	Ratio in light A/B.	Ratio A/B in dark after exposure to light.
Guinea-pig A .	473 gm.	0·881 . 1	0·969 : 1	. .
Guinea-pig B .	517 „			

Note.—The animals were white in colour, but there was a big dark brown patch on the side of guinea-pig B.

From Tables I. and II. it would appear that when the animals were placed in the dark after exposure to light the order of their metabolic activities was reversed, that is, the animal exposed to the polarised light showed diminished activity compared to its fellow exposed to the ordinary light. This would seem to suggest that there is compensatory rest after the increased metabolic activity induced by the polarised radiations.

Further work is in progress.

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Energy Levels of the Carbon Monoxide Molecule.

IN a recent letter to NATURE (vol. 117, p. 376, 1926), Dr. R. C. Johnson shows that the third positive carbon bands are related to those recently discovered by Cameron (*Phil. Mag.* (7) 1, p. 405, 1926), and that the final states of the Cameron bands are identical with the final states of the fourth positive carbon bands As the fourth positive bands are known to belong to the neutral carbon monoxide molecule from Leifson's absorption experiments (*Astro. Jour.*, 63, 73, 1926), Johnson concludes that Cameron's bands and the third positive bands also belong to the neutral carbon monoxide molecule. We have recently completed some experiments on the excitation of the carbon monoxide spectra by electron impacts which support the views of Johnson, and they enable us to extend the scheme of energy levels so that it includes all of the bands of carbon monoxide.

We employed hot cathode discharge tubes and measured the excitation potentials of the several systems by a photographic method. A part of the third positive bands appear at 10·2 volts in agreement with the energy level assigned to them by Johnson, but another set appears at 11·1 volts or at a 0·9 volt higher level. These bands were shown to have the same final states as the set which appears first, and when so analysed, indicate that they originate in a single state 8258 cm.$^{-1}$ above the first set. This difference in levels corresponds to 1·02 volts, in agreement with the difference in their measured excitation potentials. As this difference is rather large to be ascribed to a vibrational shift, we have concluded that the second set constitutes a different system, having final states identical with those of the third positive system but originating in an electronic level 1·02 volts higher than the zero vibrational level of the third positive bands. We shall refer to these bands as the 3A system. Their structure is quite different from the others, whereas they would be expected to be similar if they all belonged to the same system. The following bands constitute the 3A system: λ2295·2, 2389·0, 2489·9, 2597·1, 2711·35A.

Having now separated one set of bands from the third positive system, it is possible to arrange the remaining bands into two series having the same final states and having initial states differing by 2210 cm.$^{-1}$, which difference can be ascribed to a vibrational shift. Thus there are two initial vibrational levels for the third positive system and only one for the 3A system. When the molecule is in such highly excited states it cannot suffer very large nuclear displacements. The same thing is illustrated by the few initial states of the Ångström system.

The third positive bands have usually been ascribed to carbon dioxide, instead of to carbon monoxide, because it was believed that they are of too complex structure to belong to a simple diatomic molecule. However, their relation to the Cameron bands points strongly to carbon monoxide as their origin, as suggested by Johnson. Further evidence that carbon monoxide, and not carbon dioxide, is the origin of these bands has been obtained by the writers in collaboration with Prof. E. F. Barker of this laboratory. Carefully prepared and purified carbon dioxide was excited by electron impacts in a three electrode discharge tube through which the gas was caused to flow at a constant rate (Barker and Duffendack, *Phys. Rev.*, 26, 339, 1925). The gas passed through the region of excitation before it could come into contact with the filament, and oxide coated platinum filaments were used in order to reduce the amount of thermal dissociation, and so the amount of dissociation products that could find their way into the region of excitation was negligible.

With this apparatus, the bands of the third positive system were not observed unless a considerable voltage was applied to the electrodes. When they did appear (and they were always of feeble intensity) they were invariably accompanied by the Ångström bands. Their presence under these conditions can be accounted for by the dissociation that occurs in the discharge at high voltages. When, however, the flow of gas was stopped and the stagnant gas excited in the tube, these bands and the Ångström bands appeared strongly in the discharge at much lower voltages. At the same time the pressure in the tube increased, indicating that the carbon dioxide was being dissociated by thermal action at the filament. It is concluded from these experiments that the third positive bands, like the Ångström bands, belong to the neutral molecule of carbon monoxide.

In possessing the two parallel sets of electronic energy levels, carbon monoxide is, so far as the writers are aware, unique. It probably means that the molecule has two distinct types of spectral terms corresponding to different types of electronic orbits. It may be worth while to consider, as an hypothesis, that one set of levels is made up of triplet terms and the other of singlet terms in analogy with the term scheme for the 'corresponding atom.'

In pursuance of this idea, it would be concluded that the complex structure of the third positive bands may be due to the overlapping of bands from the several levels of the triplet terms. Separations of the order of magnitude as occur in the triplet terms of Mg would result in a superposition of the bands from the several levels and cause an apparent complexity of fine structure. The diminution in the triplet separations in the higher terms would result in a simplification of the structure of the bands originating at these levels, and this may account for the simpler nature of the bands of the 3A system. On the other hand, the singlet levels would produce bands of greater simplicity like those of the Ångström and fourth positive systems.

O. S. DUFFENDACK.
GERALD W. FOX.

University of Michigan,
May 30.

Hydrogen as Anion.

NOT every one can entertain the wild and woolly west—it is some feat! Still, I should be better pleased, if, instead of entertaining Prof. Lewis, I had led him to be serious and consider the depth of crime he is guilty of in aspersing the character of hydrogen as he has done. Being subversive of all that chemists have taught, the doctrine he preaches, that it is the analogue of fluorine and can act as an *anion* and as bigamist, is not one to be put forward in the light and airy manner he adopts—without considering the consequences. If its effect were confined to the Pacific coast, we here might regard such speculation with complacency—following the example of the Professor's countryman, who, during the civil war, expressed his readiness, rather than that it should come to an end to his disadvantage, to see every drop of blood shed from every vein of every one of his wife's relations. When, however, the morals of Cambridge and Oxford suffer, especially when one whom I long sought to train in the ways of righteousness, whose hand and eye work I have always greatly admired, preaches it as gospel in the tabernacles of Belgian, British and French chemists, I feel bound to protest. Men of his type, with an ever waxing clerical diathesis, are dangerous to society, when they begin to imagine and preach heresy—their accolytes tend to take them seriously, not realising that they are but acting the Huck Finn to some distant Tom Sawyer.

Let us admit that to-day chemistry is mainly a Huck Finn-Tom Sawyer business: any one who was present at the recent Faraday Society discussion on explosions and has listened to talks on tautomerism and polarity at the Chemical Society must see that such is now our condition. We just "let-on": the laboratory is fast passing into insignificance, the close study of *materia chimica* is a practice of the past, the judicial spirit is gone, engulphed in the Scandinavian wave, jesuitry prevails instead.

Prof. Lewis merely "lets on": he has no solid ground of evidence. His contention involves the assumption that calcium hydride is an electrolyte. Hittorf's early definition: "Electrolyte sind Salze" still remains the one concise and consistent statement concerning the facts. No pure binary hydride has yet been shown by valid evidence to be an electrolyte, let alone a salt. Prof. Lewis very properly raps me over the knuckles on account of my reference to potassium—an obvious howler. Incidentally, let me say, nothing is more strange than the way in which blunders are unconsciously made in writing and, being made, remain undetected until after an interval—only recently, when filing my letter, did I suddenly realise what a fool I had made of myself.

Prof. Lewis might, however, have taken the hint I gave him. The Bardwell experiment was not made with the metallic hydride but with a solution of the hydride in an eutectic mixture of lithium and potassium chlorides—both electrolytes. Is it not rational to suppose that only the chloride was electrolysed and that hydrogen was but the product of a secondary change? In other words, that it was displaced by the 'nascent' chlorine—hence its appearance at the anode. Bardwell makes no reference to an evolution or appearance of chlorine but calmly assumes that the hydride acts as the electrolyte. Even Prof. Lewis, I imagine, will not contend that the chlorides are unaffected by the current.

Hydrogen, however, will take care of itself. What concerns me is the future of our science. All my life, an advocate of training in the use of scientific method, I find little or no evidence in our ranks of the complete intellectual probity the practice of the method involves. The young student goes to the university in full honesty of purpose, his parents expecting that he will be trained for his life-work. Instead of science he finds nescience. The consequences are already seen to be disastrous both to scientific and industrial progress. Men who are both rational and reasonable, with some breadth of knowledge and outlook, observant and reflective, fit to take charge of posts of importance and responsibility, are not to be found among young chemists to-day. The wrong type of man is being forced into the profession and, even when one of the right type comes forward, the superficial training that is given but unfits him for the service of the world.

HENRY E. ARMSTRONG.

The Sensitivity of Selenium Cells.

MR. THORNE BAKER's observations on the enhanced light sensitivity of selenium cells actuated by alternating, instead of direct, current (NATURE, June 19, p. 858), are possibly related to some phenomena investigated recently by Mr. J. W. Avery and myself. We have found that selenium cells of a particular type (those made to the design of Prof. H. Thirring) display, when used in the ordinary way with direct current, appreciable and persistent polarisation effects. Almost accidentally it was discovered that this polarisation disappeared as a consequence of prolonged exposure of the cell to the operation of a drying agent. By the same process the 'dark' conductance of the cell was reduced in the proportion of about 4 to 1, while the 'light' conductance was scarcely altered. The dried cell had thus become much more sensitive to light. We have attributed both the polarisation observed and a large part of the 'dark' conductance of the undried cell to the presence of a film of water in parallel with the selenium between the electrodes, and our observations agree quantitatively with this assumption.

We have also obtained some evidence of the existence of a much more transient polarisation in the desiccated cell, leading to a difference of conductance according to whether alternating or direct current is used, but this work is, for the present, incomplete. What has been established is that quite apart from the question of current alternation, the sensitivity of certain selenium cells, and probably of others, can be greatly increased by the simple process of thorough drying. The record of our work on this subject has been completed for publication and will, it is hoped, appear shortly.

A. O. RANKINE.

Imperial College of Science and Technology,
South Kensington, S.W.7, June 20.

Luminous Night Clouds.

DR. G. M. B. DOBSON, in his recent Halley lecture on, "The Uppermost Regions of the Earth's Atmosphere," makes mention of the phenomenon of 'luminous clouds' (NATURE, May 15, 1926, vol. 117, p. 697).

These clouds, discovered in 1885 by Prof. Ceraski, Moscow, may be observed in northern latitudes,

FIG. 1.—Luminous night clouds on August 8-9, 1925, 22 h. 47 m. U.T. Exposure 2 min.

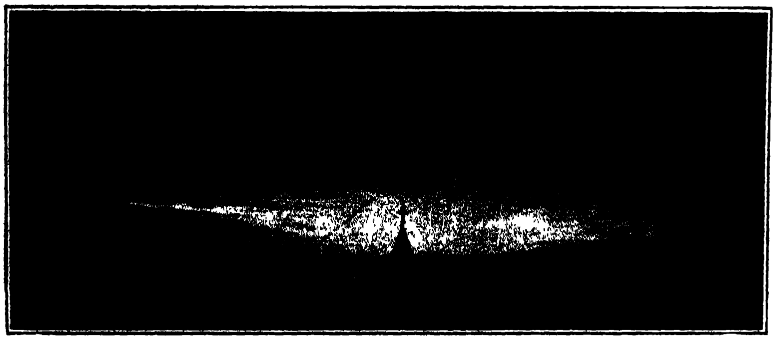

FIG. 2.—Luminous night clouds on August 8-9, 1925, 23 h. 29.5 m. U.T. Exposure 3 min

50°-60°, during the summer period, between the middle of May and the middle of August; in the southern hemisphere they are observed from November to February.

The 'luminous' clouds are rather like the 'cirri' in appearance, but they seem to gleam on the background of the segment of the dawn, whereas the common 'cirri' appear dimmed and dark when seen against the sky at dawn. The characteristic feature of luminous clouds appears to be, as indicated by O. Jesse, their unchangeable altitude over the earth's surface; on the average about 82 km. It is interesting to note that the Heaviside layer, which plays such an important part in radio telegraphy, is at the same height of 80 km.; moreover, according to Trowbridge (*Astrophys. Journal*, 1907), the tails of meteors are generally also observed at this same height (87 km.). These facts indicate peculiar properties for the layer lying at an altitude of 80-85 km. above the earth's surface; it seems possible that all phenomena observed at this height are closely connected with one another.

Our knowledge of luminous clouds is very incomplete and we have no satisfactory theory relating to their origin. The hypothesis of volcanic origin, maintained for some time after the first observations of luminous clouds in connexion with the eruption of Krakatao in 1883, had to be rejected, these clouds being observed almost every year, and independently of volcanic eruptions.

Lately (*Met. Zeitschrift*, Oct. 1925) a theory proposed by A. Wegener regards luminous clouds as being due to condensation of normal water vapour; this theory, however, has also met with many objections (*Met. Zeit.*, Mar. 1926.)

Luminous clouds, after being a vary rare phenomenon for a certain period of time, were again frequently observed during recent years. They were observed in Russia in 1916-19-20-22-23-24, and 1925; on the night of August 8-9, 1925, I succeeded in obtaining six photographs of these clouds from Leningrad at the Astronomical Observatory of the Russian Amateur Society for the Study of the Universe (Mirovédénïé) and the Scientific Institute of P. F. Leshaft (Figs. 1 and 2). The measurements of the photographs showed that the clouds, having started from a point 13° to the east from north, moved with the velocity of 230 metres a second to the south-south-west.

A detailed account of these observations will shortly appear in the Journal *Mirovédénïé* (vol. 15, No. 2, 1926).

We consider observations of luminous clouds to be extremely valuable and should feel greatly obliged if any one would send to us duplicates of observations made either at the present time or relating to any other epoch. Photographs would be especially valuable.

Guidance as to methods of making these observations may be found in an article by W. Foerster and O. Jesse in *Astron. Nachrichten*, Bd. 130, 1892.

V. MALZEV.

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June 14

Magnetic Properties of Single Crystals of Iron.

REFERRING to the letter in NATURE for May 29, p. 753, by Messrs. Honda, Kaya and Masuyama, it will be noted that Fig. 1, showing the magnetisation curve for a large crystal of iron, indicates the occurrence of definite and distinct steps in the magnetisation curve, but no explanation is foreshadowed.

In the *Journal of the Institution of Electrical Engineers* for September 1920, vol. 58, p. 832, I suggested that such steps were likely to be found in the magnetisation of iron crystals on the probability that more than one configuration would be involved before saturation was reached. Any such steps would be hidden in commercial iron owing to the irregular arrangement of crystals and the resultant overlapping in their individual characteristics, but in an individual crystal with a wholly symmetrical arrangement one would expect a relatively sudden change of pattern falling into a different space-lattice.

It would be interesting now to have an X-ray examination made of the crystal to ascertain the configuration corresponding to each stage of the magnetisation curve.

E. B. WEDMORE,
Director and Secretary.

The British Electrical and Allied Industries
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London, S.W.1, June 22.

Climatic Changes during Geological Times.

By C. E. P. Brooks.

I. Glacial and Genial Periods.

After the primary discovery of geologists that the various strata of rocks exposed at the earth's surface could be arranged in chronological order, and that when so arranged they represented a sequence covering a very long period of time, the most striking result of their investigations has concerned the great variations of climate which all parts of the earth's surface have passed through. Coral reefs have extended into the British Isles and central Europe, and evergreens have flourished beyond the Arctic Circle. At the other extreme, large areas now enjoying a temperate or even tropical climate were covered by thick ice-sheets.

The evidence for all these changes is now so abundant that the general facts can no longer be questioned, though there are still differences in the interpretation of details. Thanks to this patient accumulation of evidence, we are now well acquainted with the climatic history of most parts of the earth's surface. Only the very oldest strata, the Archæan, composed of gneisses and similar rocks, are so altered that they give practically no information as to the climate prevailing when they were formed. At one time they were believed to be remnants of the earth's original crust, born in fire, but although the uranium-lead and thorium-lead ratios show that, according to the usual method of computation, some of these rocks are so much as 1600 million years old, the astronomical calculations summed up by Harold Jeffreys point to the age of the solar system as being very much greater still. Hence it is very improbable that any parts of the original crust of the earth still remain accessible.

The sedimentary rocks formed in the succeeding Proterozoic era are in many localities sufficiently unaltered to indicate the conditions under which they were laid down. During the greater part of this era the prevailing deposits were sandstones, such as the thick Torridonian Sandstone of Scotland, and limestones, but in many widely separated areas glacial deposits have been found—near Adelaide in Australia, in the Himalayas, South Africa, the United States, the head of the Yang-tse River in China, and perhaps also in Scotland and the Varangerfjord in Norway. The glacial phenomena at the latter site are very fine; they may be of any age from Proterozoic to Permian, but are most probably Lower or Middle Cambrian. The succession of events is best shown in Australia, where ancient boulder-clays or 'tillites' have been found on two horizons separated by 9000 feet of conformable strata. The later of these two tillites occurs probably just below the base of the lower Cambrian. Two glacial horizons, one probably just pre-Cambrian and the other much older, have also been recognised in South Africa, and possibly in the United States and India.

The Palæozoic was thus ushered in by an ice-age, but by the Middle Cambrian all traces of glaciation, with the possible exception of the Norwegian, seem to have disappeared, and by the Upper Cambrian at least mild climates had developed in all parts of the world. The temperature was not the same in all latitudes; for example, the Archæocyathinæ, which are fully developed in Australia, are dwarfed and crippled in the Antarctic, but the zonal differences were less than at present. The Ordovician period was one of prolonged warmth; in the Silurian this general warmth continued, and corals spread into all latitudes, though in the Arctic only isolated dwarfed forms occur. The Silurian also gives us some evidence of the development of desert climates, while in south-east Alaska, and possibly in Tasmania, there are traces of ice action. In the Lower Devonian the faunal zones became more accentuated, and there is evidence of ice action at Table Mountain in South Africa and probably also in the Falkland Islands. In the Upper Devonian, however, the general warmth appears to have returned, and in the Old Red Sandstone extending from England to the Baltic States we have evidence of a widespread arid region, which Walther compares with the interior of Australia or with the Trans-Caspian desert. The prevailing warmth continued into the Lower and Middle Carboniferous, when thick coral reefs were formed in middle latitudes and a cosmopolitan flora spread over the greater part of the land surfaces, but in the Upper Carboniferous the ice-sheets returned over very wide areas.

This ice-age is generally termed the 'Permo-Carboniferous,' because when its remains were first discovered they were believed to fall mainly at the junction of these two periods. It now appears that the ice reached its greatest development in the Upper Carboniferous, when the ice-covered area was probably greater than at any other time in the earth's history. The most remarkable feature of this glaciation is the distribution of the ice-sheets—a large part of Australia, South Africa, India, eastern South America from southern Brazil to the Falkland Islands. This immense area, much of which is now within the tropics, was covered, not by local valley glaciers, but by immense regional ice-sheets. The striæ indicate that the ice moved southwards in Africa, but northwards in India, *i.e.* away from the equator, but in Australia the centre of dispersal lay to the south-west of Tasmania. Farther north there are some rather doubtful glacial deposits in Europe—Germany, France and Holland—and a large amount of quite definite evidence of glaciation in North America, where the glaciers appear to have attained a considerable size and to have reached the sea. The most interesting glacial deposits in North America, the 'varve' clays associated with the Squantum tillites, will be referred to later. No Carboniferous glacial deposits have yet been discovered in the Antarctic.

Apparently contemporaneous with the ice-sheets was the rich flora of the Coal Measures in North America, Europe and Asia, which developed from the cosmopolitan flora of the Middle Carboniferous, but in Australia, India and South Africa a new flora of hardier appearance developed above the glacial deposits—the Glossopteris flora.

In the Upper Permian the climate again became generally warm and dry, and this initiated a long period of genial climate which persisted with only minor interruptions throughout the Mesozoic and the greater part of the Tertiary. There was floating ice in the English chalk seas and in Australia in the Cretaceous, and Alpine glaciation in the Antarctic and

in the San Juan Mountains of Colorado in the Eocene, and perhaps in the Italian Alps in the Miocene, but the general impression given by the Jurassic coral reefs of Europe and the Upper Eocene Arctic flora is one of slight differences of temperature between different latitudes and warm ocean currents penetrating into the neighbourhood of the poles.

During the Pliocene the temperature began to fall rapidly, and it is probable that quite early in this period the Antarctic ice reached the sea, while a boreal fauna developed in the Arctic Ocean which spread out into the Atlantic, and early in the Quaternary penetrated into the Mediterranean. During the latter period glaciers formed on the mountain ranges in all parts of the world, developing into great ice-sheets in the north temperate zone, where there were four main advances of the ice—the well-known Gunz, Mindel, Riss and Wurm stages of Penck and Brückner's classification. Since the maximum of the Wurm there have been several minor oscillations, passing gradually into the present climate.

The outstanding features of this history are the alternation of glacial and genial periods and the association of glaciation with mountain-building, of warmth with periods of rest. The Lower Proterozoic glaciation was associated with great outpourings of lava, the Late Proterozoic-Early Cambrian glaciation coincided with a period of disturbance, the Upper Carboniferous glaciation followed the Hercynian folding, and the Quaternary glaciation followed the culmination of the Alpine folding. Minor periods of unrest, such as those of the Silurian or Cretaceous, were followed by minor deteriorations of climate. This orogenic-climatic cycle becomes more obvious when the dates are considered. The Quaternary glaciation was an affair of yesterday. The radio-active clock (according to the usual basis of calculation) gives the age of the Upper Carboniferous as 260 million years, and the base of the Cambrian as 500 million years. The interval between the two Proterozoic glaciations has not been defined exactly, but a reasonable estimate would be 200-300 million years. Thus each cycle of the geological seasons seems to have run its course in about 250 million years, giving a regular sequence which has been termed the "rhythm of geological time."

Before the causes of this grand climatic cycle can be discussed, however, the possibility has to be considered that the fluctuations were more apparent than real. In any region, such as Europe, the climatic sequence can be expressed in terms of variations of apparent latitude. This obvious fact has led to several theories of 'pole-wandering' and 'continental drift'—Simroth, Kreichgauer, and finally, the very complete and far-reaching theory of A. Wegener.[1] Wegener's work seems at first sight unassailable. The earth's surface is at present divided into a number of climatic belts—an equatorial rain-forest belt, two sub-tropical dry belts, two temperate rain belts, and finally two polar glacial caps. Now consider the climatic variations of western Europe. In the Upper Carboniferous there are the coal-measures—apparently the remains of an equatorial rain forest. In the Triassic there are desert sandstones—remains of the sub-tropical dry belt. During succeeding geological periods Europe passed successively through the warm temperate and the cold temperate belts until in the Quaternary it entered the polar glacial cap. Now go back to the Upper Carboniferous. If regions now in latitude 50° N. were on the equator, the south pole must have lain in some point now in 40° S. While Europe was much warmer than it is now, a large part of the southern hemisphere must have been much colder, and in fact a large part of the southern hemisphere now enjoying warm temperate or sub-tropical climates was then glaciated.

So long, however, as the continents remained in their present positions relative to each other, some parts of the southern glaciated region must fall in low latitudes no matter where the south pole is placed. Wegener gets over this difficulty in two ways. First, he considers that the relative positions of the continents have not remained the same. Continents are composed of masses of relatively light rock (sial), embedded in heavier rock (sima) which under long-continued pressure acts as a viscous fluid. Hence under the continuous action of any horizontally directed force the continents will drift through the sima. The east coast of America fits so neatly into the west coast of Europe and Africa that there is good warrant for believing that the two were formerly united and have recently drifted apart; there is some geological and biological evidence in support of this view. Similarly, though on less plausible grounds, Wegener effects a *rapprochement* of Africa, India, Australia and the Antarctic continent, the whole forming in Carboniferous times a compact continent or 'Pangæa,' centred near the south pole. But even this is not enough; parts of the glaciated area of Pangæa extended into temperate latitudes, and Wegener further supposes that the south pole described a wide curve through this primitive continent, so that different parts of the land area were glaciated at different times.

Wegener accounts for the long periods in which there is no evidence of ice action anywhere on the earth by supposing that during these periods the poles lay near the centres of extensive oceans, while during the glacial periods the poles lay near or over the land. In the Miocene the north pole is placed over Alaska, whence it moved eastwards across North America and Greenland to the neighbourhood of Spitsbergen. Thus the 'Quaternary' glaciation of America is older than that of Europe. The succession of glacial and interglacial periods is accounted for by Köppen[2] on astronomical grounds.

The whole work is wonderfully ingenious, and it has been accepted by many geologists. There are, however, a number of very serious objections to it. The forces which Wegener postulates to move the continents are twofold—a tidal force acting from east to west, which is indefinite but may be large, and a very small drift towards the equator which is common to all floating bodies. H. Jeffreys[3] considers that while the deeper layers of the sima are viscous, the surface layers are too rigid to allow these small forces to act. Joly's recent theory of the cyclic melting and solidifying of the sima[4] may provide an escape from this objection, and

[1] Wegener, Alfred, "The Origin of Continents and Oceans." Transl. by J. G. A. Skerl. London, 1924.

[2] Köppen, Wladimir, und Wegener, Alfred, "Die Klimate der geologischen Vorzeit." Berlin, 1924.

[3] Jeffreys, Harold, "The Earth; its Origin, History and Physical Constitution." Cambridge, 1924.

[4] Joly, John, "The Surface-history of the Earth." Oxford, 1925.

we may perhaps grant the possibility of east-west movement for which there is some geophysical evidence. But the "flight from the poles" is another matter, and in fact, according to Wegener's reconstructions, during a large part of geological time the main mass of land in the northern hemisphere was moving, not *from*, but *towards* the north pole. The evidence for these movements is entirely palæoclimatic, and needs to be very convincing to support such far-reaching deductions. Is it convincing? Leverett's comparative studies of European and North American glacial deposits do not bear out the assumption that the main part of the American glaciation is far older than the European. According to W. H. Dall the Miocene glaciation of Alaska is a myth, the main glaciation of that country having occurred in the Quaternary. The mild polar climates of the Upper Eocene cannot be accounted for by movements of the poles, since Berry has shown that a flora allied to the present temperate flora completely surrounded the north pole in high latitudes, forming a ring out of which it is impossible to bring the pole in any direction. The desert deposits of the Mesozoic are practically limited to the latitudes in which deserts are found at present. Wegener's reconstructions do not account at all for the climatic sequence in the Antarctic, as recently set out by Wright and Priestley.[5] There remains the Upper Carboniferous period.

[5] British (*Terra Nova*) Antarctic Expedition, 1910–1913, "Glaciology," by C. S. Wright and R. F. Priestley. London, 1922.

Most meteorologists would say that the development of extensive ice-sheets reaching sea-level within the tropics is inconceivable, and that for the Upper Carboniferous Wegener's theory offers the only possible solution. The succession of glaciations in different continents following a moving pole is not tenable in the light of recent geological work, which seems to demonstrate the approximate synchronism of the glacial maximum in all countries, but this scarcely affects the main problem. A more serious objection is the Upper Carboniferous glaciation of North America, which Wegener's reconstruction places on the equator. Evidence has been found that in Oklahoma, Arkansas, Massachusetts, Nova Scotia and perhaps in other regions also, powerful glaciers reached the sea, and icebergs or heavy shore ice transported large boulders fifty miles or more from their original source. The best development is seen in the Squantum beds near Boston, where, in addition to thick tillites, there are seasonally banded clays which are similar in all respects to the 'varve' clays formed during the retreat of the Quaternary ice-sheets in Sweden, Finland and North America. The glacial nature of these beds appears to be incontrovertible, and the well-marked seasonal banding appears to be incompatible with their formation on the equator. Whether Wegener's theory is adopted or not, the climatological problem presented by ice reaching sea-level within the tropics still remains to be solved.

(*To be continued.*)

On the Rare Earths.

THE group of about sixteen elements the oxides of which are popularly known as 'rare earths' are characterised by an exceedingly close relationship in their chemical and physical properties—a relationship which, in its intimacy, is not paralleled by any other group of elements. In consequence of this fact, the task of isolating the individual members of the group has been one of quite exceptional difficulty. Until recent years, practically every reported discovery of a new element of the group was proved, by later searching investigation, to be not one element, but two or more. In addition to this difficulty has been that of distinguishing an alleged new element from some other previously discovered element, with the result that one and the same element was discovered over and over again, each discoverer giving it a separate name. Hence, the chemistry and the nomenclature of the rare earths were for many years in a state of almost hopeless confusion from which they have emerged only during the present century, and particularly in the last decade.

The history of the discovery of the rare earths goes back to 1794 when Gadolin discovered the yttrium earths, out of which a considerable number of separate elements have since been identified. By the discovery of ytterbium and cassiopeium (or lutecium) by Auer von Welsbach in 1906, it was thought that the whole of the rare earths had been discovered, and it was not until the development of the atomic number rule by Moseley that it was found that a space in the series, corresponding to an element with an atomic number of 61, was vacant. There is now fairly conclusive evidence that, after a great amount of work by various investigators, including an exhaustive and negative examination of rare earth fractions by Prandtl and Grimm extending over a year, this element has been definitely identified by the use of the X-ray spectrum. There is also good reason for supposing that with the discovery of illinium, the name given to the supposed new element, the whole of the rare earth elements have been found and identified.

The term 'rare' as applied to these elements is relevant only in the case of a small minority of them. Cerium, believed to be the most abundant, is considered to be little, if any, scarcer than nickel, and many of the others are far from being scarce, even if concentrations of them are not common. On the other hand, a few of the elements appear to be among the rarest known, and this appears to be particularly true of erbium, and the element 61, which has so long eluded the searchers for it and even yet has not been found in measurable quantity.

The primary occurrences of the rare earth minerals in Nature are confined mainly to pegmatite dykes or pegmatitic rocks, considered to have been formed during the last phases of crystallisation and differentiation of an intrusive magma, that is to say, to the phase following acid rock formation. But rare earth minerals are usually not present in important concentrations in the primary rock formations, and it is only by the denudation of the containing rocks and the natural concentration of the relatively heavy minerals set free that accumulations representing any appreciable quantity of the material are formed.

The main source of the rare earths, so far, has been

monazite sands found in considerable accumulations in Travancore in India, Bahia State in Brazil, as well as in Ceylon and a number of other places in the world. The composition of monazite sand is complex, but essentially it consists of the phosphates of cerium and lanthanum. But the economic value of the sands depends on the percentage content of thorium minerals which are now used so extensively in the manufacture of the incandescent gas mantle. The cerium content has some economic value, being also used in small proportion in the incandescent mantle industry, and also for the manufacture of ferro-cerium, well known in the form of the sparking type of lighter.

The following are partial analyses of two samples of monazite sand, one from Travancore and the other from Bahia:

	Travancore. Per cent.	Bahia Per cent
Thoria	9·43	6·50
Ceria earths	31·90	61·40
Lanthanum earths	28·00	
Yttria earths	0·46	0·70

The yttrium earths have been used in the manufacture of the incandescent parts of Nernst lamps, but for most of the other rare earths no industrial outlet has been found. In some quarters it has been suggested that certain of them may prove valuable as catalysts.

With reference to the close association of the rare earths in Nature, it is obvious that since the chemist finds so much difficulty in separating these by methods of great refinement, the crude large-scale metallurgical processes of Nature must tend to segregate them in groups rather than separately. The rare earth group is scarcely unique in this respect; the platinum group of metals is a more or less parallel example where the so-called native platinum may be, and often is, a complex alloy of platinum, iridium, osmium, palladium, ruthenium and other metals. All of these metals possess closely related physical and chemical properties which lead to their segregation in the basic and ultra-basic differentiations of an intrusive magma. The rare earth minerals, however, mainly associate themselves with silicious and aluminous magmas.

The conception of atomic numbers and the history of the discovery that X-ray spectra could be used in the identification of previously unknown elements have formed the subjects of numerous articles and communications in the scientific and philosophical press and need only be briefly mentioned here. The names associated with these discoveries include, among others, those of Laue, W. H. and W. L. Bragg, and Moseley, to all of whom great credit is due for their respective parts. Moseley's work in connexion with the development of the atomic number rule has been especially valuable. In the field of the rare earths, the determination of the atomic numbers has revealed definitely the possible number of distinct chemical elements. Between barium with an atomic number of 56 and tantalum with an atomic number of 73 there is room for sixteen elements. Prior to 1923 it was possible to speak of only fourteen of these elements as definitely known, but with the discovery of hafnium with an atomic number of 72 by Coster and Hevesy by means of the X-ray spectra, and the later discovery by Prof. B. S. Hopkins and his associates of what seems to be element No. 61, the sequence from 56 to 73 is complete and justifies the claim that all the rare earths have been discovered. The X-ray method of investigation also leaves no room for assuming that the list of rare earth elements contains duplicated cases, and that the same element may be regarded as two distinct elements under different names. The indications obtained by that method are open to one interpretation only, and those characteristic of a given element are distinguished without difficulty and beyond reasonable doubt.

From its simplicity, ease and rapidity of the experimental examination, the determination of the X-ray spectrum is becoming of the greatest importance in the investigation of particular elements in a mixture, and in the control of separations; it will most probably, in a large degree, if not entirely, replace the much more complicated and troublesome examination of the light emission spectrum. Not only are elements identifiable by this method with a rapidity and certainty which far surpass those of other methods, but a comparison of the densities of the lines with that of the lines given by a known quantity of a foreign element will give approximate quantitative results.

The method of using the apparatus presents no difficulty. The apparatus is arranged in much the same way as an ordinary spectrometer; the incident light is replaced by the beam of X-rays from the material under examination, which forms the anti-cathode, in a vacuum tube. The diffraction grating is replaced by the crystal slice, and the telescope and eyepiece (or photographic plate) by an ionisation chamber by which the intensity of the reflected beam may be measured.

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Television.

THE possibility of 'seeing by telegraph' was fully recognised many years ago. The discovery that the electric resistance of selenium varied with the intensity of the light falling on it suggested to Professors Ayrton and Perry, amongst others, that the method was theoretically feasible. It was soon found out that selenium failed to respond quickly enough to the rapid changes in light intensity necessary for television, and it was not until the photo-electric cell had been perfected that inventors seriously attempted to solve the problem. The analogous problem of sending photographs and pictures by telephone wires or by radio waves, or by both these methods, we can consider as solved. It is now done commercially. Doubtless great improvements in the method will be introduced, and before very long every one will accept it as a commonplace operation and cease to regard it as wonderful.

The problem of television, however, is an immensely more complicated one, and even the most optimistic of scientific men had begun to think that it would be

many years before the first glimmering of a practical method would be developed. We were therefore agreeably surprised on making a visit to Mr. J. L. Baird, at Motograph House in Upper St. Martin's Lane, London, W.C., to find that he had installed there a transmitter and a receiver which prove that he has made great progress in solving the problem. We saw the transmission by television of living human faces, the proper gradation of light and shade, and all movements of the head, of the lips and mouth and of a cigarette and its smoke were faithfully portrayed on a screen in the theatre, the transmitter being in a room in the top of the building. Naturally the results are far from perfect. The image cannot be compared with that produced by a good kinematograph film. The likeness, however, was unmistakable and all the motions are reproduced with absolute fidelity.

The general principle utilised by Mr. Baird is not difficult to understand. The image of the object to be transmitted is made to traverse a cell sensitive to light. This cell modulates an electric current. When the light on the cell is intense the current is large and when the cell is in shadow it is weak. At the receiving station the current controls a source of light which traverses a ground glass screen which moves in exact synchronism with the image at the transmitter. The spot of light is therefore bright when the light on the transmitter is intense and dark when it is in shadow. The light from the image moves over the screen about ten times a second. Hence, owing to the persistence of vision, a complete image is obtained.

Just as in the early kinematograph films, there is a constant flicker, but this will doubtless be got rid of in whole or in part in the new Baird 'televisor.' This is the first time we have seen real television, and, so far as we know, Mr. Baird is the first to have accomplished this marvellous feat. He had the first inkling of the method two years ago when he successfully transmitted shadows by electricity. We were told that a similar method of transmitting shadows has been independently devised in America. But his present method is as superior to the shadow method as a photograph is to a skiagraph.

It is natural that Mr. Baird and his partner, Capt. Hutchinson, should contemplate a great future for television. They are taking steps in the direction of having a broadcasting system of television for London. Every possessor of a 'televisor' will be in a position to see on his screen the performers in operas and plays as well as hearing them. They expect to make a start in this new system of broadcasting next year. The new discovery will in no way interfere with the ordinary British broadcasting. The Post Office officials, seeing the probable advent of a new British industry, regard the scheme with benevolent neutrality.

Those of us who remember the advent of the telephone in 1876, and remember also how little its importance was then realised, will hesitate to criticise this new invention. There is endless scope for improvement. Mr. Baird, who, like Graham Bell, is a Scotchman, has been so extraordinarily and so rapidly successful in the past that we have great hopes that he will soon perfect his invention to the commercial stage. We wish him every success.

A. R.

Solar Surveys.

OUR Supplement this week will be read with great interest by specialists in solar research, and also by a considerable number of other readers to whom Dr. Hale's name is closely associated with the Mount Wilson Observatory and the progress of astrophysics. Since 1923 Dr. Hale has been engaged in perfecting an instrument for *visual* observation of the sun in monochromatic light; and the spectrohelioscope, as he calls it, is now permanently installed at his new solar laboratory at Pasadena. The recent increase of solar activity shown by sunspots, flocculi, and prominences has afforded him ample opportunity for testing the capabilities of the instrument. Its performance appears to have exceeded all expectations, and a rich harvest of results may be anticipated, especially with respect to observations of the sun's upper atmosphere and the hydrogen vortices registered in the light of $H\alpha$. These hydrogen vortices, which have been studied almost exclusively since their discovery in 1908 by Dr. Hale and his colleagues at Mount Wilson, are bound up with the problem of the nature of sunspots and their unexplained reversal of magnetic polarity at each spot minimum. The development of the spectrohelioscope, its uses as a powerful instrument of research, and a survey of results obtained to date are reviewed by him in this week's Supplement.

It is a matter for comment that the development of the spectrohelioscope was delayed by slight circumstances for more than fifty years. As Dr. Hale reminds us, the pioneers of solar spectroscopy, such as Jannsen, Lockyer, and Young, were fully aware of the principle involved; Young, indeed, constructed a spectrohelioscope for seeing the prominences at the sun's limb, but it was never applied for observing phenomena on the disc. The wide slit method for prominence work, introduced in the meantime by Zöllner and Huggins, was so successful that a narrow oscillating slit—one of the essentials of the spectrohelioscope—was abandoned, and later experiments, then directed to *photographic* registration in monochromatic light, resulted in the spectroheliograph by Hale and the velocity spectrograph by Deslandres. Thus the need for a visual survey of the sun's atmosphere projected against the disc persisted until the construction of Dr. Hale's spectrohelioscope.

Of the many interesting observations, described and beautifully illustrated in Dr. Hale's characteristic manner, attention may be directed to those by which the observer views in rapid succession the ascending and descending portions of the same hydrogen flocculus and the sunspots which may happen to lie beneath. Dr. Hale's enthusiasm and inventive skill are now being directed to the making of a modified form of spectrohelioscope which he hopes may be within the reach of amateurs. If these hopes are realised, the chances of detecting the exact moments of critical outbursts on the sun will, as he says, be greatly multiplied, and such observations should prove most valuable in determining the true relationships between solar eruptions and terrestrial magnetic storms.

Obituary.

MR. J. J. FLETCHER.

BY the death on May 15, at the age of seventy-six years, of Mr. J. J. Fletcher, who for thirty-three years was secretary of the Linnean Society of New South Wales, Australia has lost one of the ablest and most sincere as well as one of the most beloved of her scientific workers. He was one of the first two Australians to take a science degree at the University of London, and during his visit to England he came under the influence of the late Prof. Francis Balfour at Cambridge, an experience that exercised a lasting influence upon his work and ideals. For the last forty years his life has been devoted to the Linnean Society of New South Wales, and its work bears the imprint of his fine character in the standard which has been maintained throughout all these years. He joined the Society in 1881, and at the time of his death was the second oldest member. During the course of his tenure of the secretaryship of the Linnean Society he also controlled the general management of the Society's affairs and edited the *Proceedings*. But this list of duties gives no adequate idea of the extent of his services to biology in Australia. He took his work as editor very seriously, and few of the contributors to its *Proceedings* failed to receive very material help from him in the lucid presentation of their results and in completing their bibliographical references. He was as modest and tactful as he was helpful.

Since 1881 Mr. Fletcher contributed about thirty-five important papers to the Linnean Society, including twenty-seven zoological papers, dealing largely with kangaroos, earth-worms, and frogs. He was one of the first to investigate closely the embryology of the marsupials, for which purpose he made many expeditions to collect material. His knowledge of the Australian amphibia was unsurpassed. During later years he contributed some botanical papers dealing with phases of eucalyptus and acacia seedlings. The account of his careful study of the families Loranthaceæ and Proteaceæ has unfortunately not been completed. Much of the valuable information he possessed concerning these plants has gone with him, for he was unable to find time to prepare for publication more than a very small percentage of his valuable knowledge.

On his retirement from the position of secretary of the Linnean Society of New South Wales Mr. Fletcher was made president, occupying the chair during the years 1919 and 1920, and his numerous friends presented his portrait to the Society, with a request that it be hung in the Society's hall in recognition of the great work he had so successfully carried out. He was president of the Biology Section at the Melbourne meeting of the Australasian Association for the Advancement of Science in 1900. In 1921 he was honoured by the Royal Society of New South Wales as the recipient of the Clarke Medal, "awarded from time to time for meritorious contributions to the geology, mineralogy, or natural history of Australia." At the time of his death he was a member of the council of the Linnean Society of New South Wales and a trustee of the Australian Museum.

PROF. C. J. LINTNER.

BIOCHEMISTRY of fermentation has sustained a loss by the death of Geheimer Hofrat Prof. C. J. Lintner, who died at the age of seventy years on April 8 after a long and severe illness. The deceased was the son of Dr. Carl (afterwards Hofrat) Lintner, director of what is now the Agricultural High School, Weihenstephan, who was also the founder of the Scientific Station for Brewing at Munich.

Lintner graduated at Munich in 1882 under Adolf v. Baeyer. After spending some years of work in connexion with agricultural chemistry, he became assistant at the Institut für Garungsgewerbe, Berlin, after which he acted as assistant to Soxhlet at the Landwirtschaftliche Zentralversuchsstation, Munich. In 1888 he was appointed to a chair of technical chemistry at the Technical High School, Munich, becoming "ordentlicher" professor in 1896, his work dealing more particularly with fermentation chemistry.

As regards his researches, Lintner will be chiefly remembered by his work on enzymes, more especially the amylases, and on the transformation products of starch. In 1891 he claimed that one of the products obtained from starch paste when treated with malt amylase is an isomaltose. The existence of this alleged substance was denied by Brown and Morris in 1895, and doubt was thrown on its existence by Ling and Baker in the same year. In 1897, however, Ling and Baker obtained some positive evidence of the truth of Lintner's views, whilst in 1902 Syniewski confirmed the existence of isomaltose and re-named it dextrinose. The existence of the sugar was definitely established by Ling and Nanji in 1923.

Lintner was a man of extreme amiability, and his generous and modest character won for him the esteem of his colleagues and pupils. A. R. L.

PROF. FRANZ VON SOXHLET, emeritus professor of agricultural chemistry at the Technical High School in Munich, died early in May at the age of seventy-eight years. Soxhlet was a native of Brünn, and was appointed to Munich in 1879, where he became director of the central agricultural research station. He was well known for his work on the sterilisation of milk. He did not long survive his distinguished assistant Lintner, whose death was recorded in our issue of June 12 and is referred to again above.

WE regret to announce the following deaths:

Prof. F. N. Cole, professor of mathematics in Columbia University since 1895 and secretary for many years of the American Mathematical Society, distinguished for his work on the theory of groups and the theory of numbers, on May 26, aged sixty-four years.

Dr. Henry Skinner, president in 1909 of the American Entomological Society, who was known for his work on Lepidoptera, on May 30, aged sixty-five years.

Prof. Sidney Irving Smith, professor emeritus of comparative anatomy in the Sheffield Scientific School of Yale University and a member of the National Academy of Sciences since 1884, known for his work on invertebrates, notably crustaceans, on May 7, aged eighty-three years.

News and Views.

AN extraordinary general assembly of the International Research Council was held at Brussels on Tuesday, June 29. After agreeing unanimously, on the motion of the Executive Committee, to omit from the statutes words which have limited membership to allies and neutrals, the following motion proposed by the president of the Royal Society was passed unanimously. "That this meeting of the extraordinary general assembly of the International Research Council decides to invite Germany, Austria, Hungary and Bulgaria to join the International Research Council and the Unions attached to it and, in doing so, to indicate the institution which will act as adhering body."

THE second reading of the Public Health (Smoke Abatement) Bill was moved in the House of Commons last week by Mr. Chamberlain. So far as it goes, the Bill is a step in the right direction. The provisions of the 1875 Act are amended to include other kinds of smoke besides black smoke; temporary exemption is to be allowed for certain processes for the present; the power of local authorities to regulate the emission of noxious smoke is to be extended. No provision is, however, made for reducing smoke from private dwelling-houses, which in many places are the greatest sinners. While the time may not be ripe for compulsory prevention of smoke from private houses, this does not appear sufficient reason for not making some provision to bring about improvement by encouragement instead of penalty, such as by empowering local authorities to make a rebate on the rates for users of smokeless methods only. In the debate, several speakers referred to the advantage of the open fire—a pleasant radiant heat and plenty of ventilation. If these can be combined with smokelessness it will be the best solution. There is in the Bill no provision for standards of permissible smoke emission, and it is doubtful if much useful result will follow until such are set up. As Mr. Chamberlain admits, it is rather on the administration that we shall have to rely for improvement of the conditions of the atmosphere, a reliance scarcely justified by our past experience. It would give more hope of improvement if the Bill empowered the Minister of Health to fix standards of industrial smoke emission from time to time; but the necessary preliminary must be the finding of a reasonably accurate method of measurement. The natural sequence would then be: (*a*) Find a suitable method of measuring smoke from chimneys; (*b*) fixed standards of emission based on (*a*); (*c*) enforce such standards legally.

THE Office d'Information scientifique et technique of Paris, the initiation of which was noted in our issue for June 12, has favoured us with copies of two recent news bulletins, which are interesting to compare with similar issues of the allied Science Service in Washington. The French material has been well selected, and is of real scientific interest; the language is plain and the treatment straightforward, but its somewhat educational tone raises a doubt as to whether the presentation is sufficiently attractive to appeal to editors and readers of the popular Press; it may be, however, that the intellectual standard in France is higher than elsewhere. In the United States and England, it is the practice to attract the reader by one or more glaring headlines, to convey the gist of the information (which should contain news) in a short initial paragraph, and then to proceed with details and embellishment. The French procedure, as displayed in these bulletins, is more logical: the headlines are distinctly sober and lacking in 'pep'; the article begins with an explanatory or historical preamble, and the news is reserved for a later stage. Although this method will be preferred by the student, it is less effective in attracting the lay reader than the more sensational style of approach.

THE 'news' element of the bulletins is not strongly represented in the specimens before us, and in a few cases, for example, the articles on telegraphic reception and the nature of X-rays, the explanations given may convey little to the uninitiated. In about one-half of the items the information comes from the United States, and the remainder from France; when the Service gets better under way one may expect material from other countries to be included. The news appears to have been culled mainly from periodical literature—which must always constitute an important source—but it is to be hoped that first-hand news obtained from research workers and inventors will later become available; in this respect the American Service has been singularly successful. It is of happy augury that the French organisation is starting with high ideals. it will not try to serve both science and mammon; commercial profit is outside its scope and there will be no traffic with the advertiser; and it will preserve a rigid independence of all parties, groups and factions. Its sole aim is the prompt diffusion of scientific and technical knowledge in a way that will neither 'mystify the crowd' nor promote sophistry and error by over-indulgence in 'purple patches.'

WE are glad to direct attention to the letter on p. 10 of this issue referring to the proposed widening of the activities of the Universities' Library for Central Europe. The original letter in NATURE of May 22 relating to the disposal of scientific journals brought responses from scientific institutions, research workers and others, from which it was evident, as we suspected, that although of no commercial value, back numbers of scientific journals and similar publications would be of very real use if they could be distributed in the right quarters. Such a central distributing organisation already exists in the Universities' Library, and we trust that sufficient support will quickly be forthcoming to enable it to undertake the new function which it is now proposing to assume.

THE first number of the *British Journal of Psychical Research*, the editorial address of which is 16 Queens-

berry Place, South Kensington, S.W. 7, merits mention in this column owing to the claim made in a foreword by the editor that one of its objects is "to deal with ascertained facts in a strictly scientific manner." It is a fine ideal to start out with, but one very difficult of attainment, apparently, in this particular subject. The account of the "Model Psychic Laboratory" on pp. 11-20, with photographic illustrations, is the best article in the number. The laboratory in question is the National Laboratory of Psychical Research at Queensberry Place, and the article is very helpful in giving a clear idea of the arrangements and apparatus in use there. We note that future numbers will contain accounts of experiments with a young psychic known as Miss Stella C., whose portrait forms the frontispiece of this number. There is also a very full account of the first case of alleged mediumship which has come up for investigation before the officers of the Laboratory. This is dealt with by Mr. Harry Price under the title of "Pseudopsychic Manifestations due to Self-induced Hysteria." The conclusion that the phenomena were all due to evident hysteria appears to cover quite fully all the facts noted. The same author, in a shorter article entitled "A Plea for Accuracy," makes some very caustic comments on an article by an American investigator, who, in dealing with the problem of so-called psychic photography, makes the remark (in italics) that "*the plates never left my hand until the negative was developed in the dark room,*" but innocently publishes alongside this statement the resulting photograph, showing a "psychic extra" on a photograph of himself in which his hands are clearly visible, and therefore could not have been holding the plate! The editor having thus set a high standard, both of accuracy in his own articles and of very candid criticisms of inaccuracies in those of other journals, we may express the hope that future numbers will worthily uphold his ideals.

The Australasian Association for the Advancement of Science will hold its eighteenth meeting in Perth, Western Australia, during the week commencing Monday, August 23 next. Owing chiefly to the long and costly journey from other parts of Australasia, no previous meeting of the Association has been held in Perth; consequently Western Australia is making special efforts to secure a good attendance of members from other States and from New Zealand. Private hospitality in Perth during the meeting is being offered to all visiting members. The State Government has granted 1200*l.* towards defraying the cost of printing and publishing, and is giving free transit to visiting members over the W.A. Government Railways, whilst the Australian Commonwealth Government has granted for the Perth meeting the sum of 750*l.*, out of which travelling allowances will be made to members coming by the Transcontinental Railway. As the various countries bordering on the Indian Ocean have many scientific problems in common, the Perth local committee has sent invitations to representative scientific men in those countries to attend the meeting, hoping thus to make it an informal Indian Ocean Science Congress, and thereby to inaugurate closer intellectual co-operation amongst the Indian Ocean peoples. To anthropologists, botanists, geologists and zoologists, Western Australia offers features which are unique, even for Australia; and a series of excursions has been arranged to enable visitors to study these as well as the economic resources of the State in mining, agriculture, fruit-growing, forestry, etc.

The retiring president of the Association is Lieutenant-General Sir John Monash, whilst the president-elect is Prof. Edward H. Rennie, of the University of Adelaide, who has chosen as the title of his presidential address "The Chemical Exploitation, Past, Present and Future, of Australian Plants." The chairman of the local committee is the Hon. P. Collier, Premier of Western Australia. The presidents of sections and the titles of their addresses are as follow: *A* (*Astronomy, Mathematics, and Physics*), Prof. Kerr Grant, "Atomic Transformation"; *B* (*Chemistry*), Prof. James Kenner, "Some Aspects of the Problem of Molecular Structure"; *B* 2 (*Pharmacy*), Mr. A. T. S. Sissons, "The Indebtedness of Pharmacy to Organic Chemistry"; *C* (*Geology and Mineralogy*), Sir Douglas Mawson, "The Igneous Rocks of South Australia—a brief survey of present knowledge relating thereto"; *D* (*Zoology*), Prof. Launcelot Harrison, "The Composition and Origins of the Australian Fauna, with special reference to the Wegener Hypothesis"; *E* (*Geography and History*), Prof. Ernest Scott, "The Discoveries of the Western Australian Coast, with especial reference to Dampier and D'Entrecasteaux"; *F* (*Ethnology and Anthropology*), Prof. F. Wood Jones, "The Claims of the Australian Aboriginal"; *G* (*Social and Statistical Science*), Major L. F. Giblin, "Federation and Finance—an Examination of the Financial Relations of States to a Federal Commonwealth"; *H* (*Engineering and Architecture*), Sir John Sulman, "Town Planning", *I* (*Sanitary Science and Hygiene*), Mr. F. S. Hone; *J* (*Mental Science and Education*), Mr. P. Board, "Social and Economic Values in Education"; *K* (*Agriculture and Forestry*), Mr. C. E. Lane Poole, "Forestry and Land Settlement"; *L* (*Veterinary Science*), Prof. J. Douglas Stewart, "The Relationship of Veterinary Science to the Prosperity of the State"; *M* (*Botany*), Prof. A. J. Ewart, "Past and Future Development of Botanical Science"; *N* (*Physiology and Experimental Biology*), Prof. W. A. Osborne, "The Study of the Reflex." The hon. local secretaries for Western Australia are Mr. A. Gibb Maitland, Geological Survey, Perth, and Prof. N. T. M. Wilsmore, University, Perth, W.A.

At the invitation of the Gas, Light and Coke Company, a large and distinguished scientific audience assembled on June 24 in the Company's offices in Horseferry Road, Westminster, to hear Prof. W. A. Bone lecture on "New Experiments on the Combustion of Carbonic Oxide." The experiments described, and in many cases beautifully reproduced, form part of researches which Prof. Bone and his

collaborators have been carrying out during the past three years at the Imperial College of Science, South Kensington, aided by fellowships given by the Gas, Light and Coke Co. and Radiation, Ltd., and described in detail in recent numbers of the *Proceedings of the Royal Society* (*e.g.* in the issue for April 1, pp. 615-44, 1926 [A]). The outstanding result of this work is that, contrary to former belief, carbon monoxide will, under suitable conditions, combine with oxygen in the absence of moisture. Mixed in the volumetric ratio of 2 : 1, at atmospheric pressure, these gases ignite with increasing difficulty as they are progressively purified from water vapour, but even after six months' drying over phosphoric oxide, they can be exploded by means of a sufficiently powerful condenser discharge. The union is facilitated by increasing the original pressure of the gaseous mixture, although it appears to reach a limiting value of about 98 per cent.

PROF. BONE stated that spectrograms obtained on exploding carbon monoxide with air, under 25 atmospheres pressure, showed the complete absence of 'steam lines,' thus proving that the presence of steam is not essential to the reaction, although under ordinary conditions it undoubtedly plays an intermediary rôle. High pressure increases the direct oxidation of carbon monoxide, whilst the presence of hydrogen, as in water gas, favours the indirect oxidation. All previous explanations of the mechanism of the combustion of carbon monoxide have assumed the continuous decomposition and regeneration of steam. Prof. Bone's 'ugly' fact destroys this 'beautiful' hypothesis, and although he has no definite substitute to advance, he believes that precedent ionisation of the combining gases is the most probable explanation. A pleasing feature of an excellent lecture was the manner in which Prof. Bone gave credit to his collaborators, Messrs. F. R. Weston, R. P. Fraser, and D. M. Newitt.

AMONG the items which are to be dealt with at the forty-fifth annual meeting of the Society of Chemical Industry in London, a session of outstanding interest will be that on Tuesday, July 20, when a symposium will be held on "Corrosion." In view of the fact that this symposium is a joint meeting of the British Chemical Plant Manufacturers' Association, the Institute of Metals, the Institution of Chemical Engineers and the Chemical Engineering Group, it cannot fail to be of very general interest. British contributions will be described by a group of recognised authorities, including Mr. Ulick R. Evans, who will deal with "The Fundamental Principles of Corrosion," Mr. P. Parrish, who will speak on "Corrosion and Erosion," and Dr. W. H. Hatfield and Messrs. T. G. Elliott and G. B. Willey, who will discuss "Chemically Resistant Steels." Possibly in no branch of metallurgy has there been such great advancement, both during and since the War, as in connexion with the production of resistant steels and acid-resisting irons. Novel methods of manufacture and the alloying of some of the less common metals with iron and steel have produced alloys of a chemical resistance quite unprecedented, and the steels which are to-day being produced to withstand corrosion are far in advance of the earlier forms of stainless steels, which are chiefly martensitic. The newer corrosion-resisting steels are austenitic, *i.e.* they are softened by quenching from a high temperature, as in the case of manganese steel, whilst the acid-resisting irons have been also greatly improved recently, both from the point of view of homogeneity and toughness, resultant upon careful methods of heat treatment. Another joint meeting on the same date, of the London Section of the Society of Chemical Industry and the Biochemical Society, is on "The Scientific and Industrial Problems presented by the Hormones—the Natural Drugs of the Body," to be opened by Dr. H. H. Dale.

IN his address to the Royal Geographical Society at the anniversary meeting on June 21, Dr. D. G. Hogarth pointed out how mistaken is the impression that no important work in geographical exploration remains to be done. Apart from polar regions, southern Arabia, and central Australia, where large virgin tracts of territory exist, there still remains a great deal to do in many parts of the world in the regions intervening between known and charted routes. For intensive surveys in topography alone there is still a great field, and an even greater one for specialists in various sciences. Dr. Hogarth commented on the ever-present appetite for the sensational which tends to divert public interest and available funds from serious work to spectacular achievements. Each air dash to the Pole probably absorbs the interests, energies, and funds sufficient to furnish a dozen expeditions which would bring a hundred times more copious and valuable returns to geographical science. As a subsidiary aid to land exploration, aircraft have proved valuable; and prolonged flights are no doubt of value in the development of aerial navigation, but they can add little of importance to geographical science. The work that is required to-day is not spectacular, but it is important and varied enough to absorb all the explorers and funds available.

THAT gold exists in sea-water is a well-known fact: that it can be profitably extracted is a belief that has enabled many a company promoter to batten upon a credulous public. This belief has now received another blow. At the annual general meeting of the Verein Deutscher Chemiker, held in Kiel on May 26-30 last, Prof. F. Haber communicated the results of a research which he and Dr. J. Jaenicke have been prosecuting for several years. Whereas earlier investigators found the gold-content of sea-water to be 5-10 mgm per metric ton, their work on 5000 samples collected from many seas and from different depths has shown that the amount present is far smaller. Water from the South Atlantic contained less than 0·01 mgm. per ton, water from the bay of San Francisco a little more, and samples from the Polar seas four or five times this quantity. Melted ice from the Polar seas was often considerably richer in gold. The form in which the gold occurs in sea-water is not, as

previously supposed, as dissolved aurichloride, but as a mineral slime or as a constituent of the plankton organisms. Its separation is effected quantitatively by adding a minute amount of alkali polysulphide and a trace of copper, and then filtering through fine sand charged with sulphur. This process, however, would not be practicable on an industrial scale. Although there may be localities comparatively rich in gold, the attempt to discover them would resemble the task of hunting for a hypothetical needle in a haystack.

VISITORS to the Natural History Museum at South Kensington should find much to interest them in the greatly augmented series of enlarged models of disease-carrying insects and ticks, which has just been arranged for their benefit in the Central Hall of that institution, and of which a demonstration was given to representatives of the press on the afternoon of June 23. Initiated more than a quarter of a century ago by Sir Ray Lankester, with models of the then best known of the tsetse-flies, and of two typical mosquitos, and somewhat extended in more recent years, the series, with the latest additions, now embraces no fewer than eleven species of insects and three arachnids. The new models among the insects include representations of the internal anatomy of an infected malarial mosquito; the common household mosquito of the tropics, a carrier of the causal agent of Filariasis; the preliminary stages of the yellow fever mosquito; the tiny, midge-like transmitter of sand-fly fever, with its larva and pupa; a small West African horse-fly, which conveys the cause of Calabar swelling; the preliminary stages of one of the tsetse-fly carriers of sleeping sickness; the eggs and mouth-parts of the body-louse; and the preliminary stages and adult female of the tropical rat-flea, the most important carrier of plague. An addition to the models of ticks is a colossal representation of the transmitter of tropical African relapsing fever. Under the supervision of members of the Museum staff, the models have been executed with remarkable skill and attention to detail by Mrs. E. D. Blackman, Miss Grace Edwards, and Mr. A. J. Engel Terzi. Now that the importance of insect-borne disease to the British Empire and the world at large is receiving ever wider recognition on the part of administrators, it is well that the matter should be brought to the notice of the general public. To this end no better means than that afforded by this striking collection of models could possibly have been devised.

ENG.-VICE-ADMIRAL SIR ROBERT B. DIXON, Engineer-in-Chief of the Fleet, has accepted the presidency of the Junior Institution of Engineers for the year 1926–1927 in succession to Mr. J. S. Highfield.

MAJOR-GENERAL SIR MATTHEW H. G. FELL, K.C.B., C.M.G., has been appointed Director-General, Army Medical Services, in succession to the late Lieutenant-General Sir William B. Leishman, K.C.B., K.C.M.G.

PROF. PAUL SABATIER, For. Mem. R.S., of the University of Toulouse, and Nobel Prizeman in 1912 for chemistry, has been awarded the Albert Medal for 1926 of the Royal Society of Arts, in recognition of his distinguished work in science and of the services to industry rendered by his researches in physics and chemistry, which laid the foundation of important industrial processes.

MR. G. S. W. MARLOW has been released by the Association of British Chemical Manufacturers to devote part of his time to the appointment of secretary and editor of the Faraday Society and secretary of the Institute of Physics, pending the completion of final arrangements for carrying on the official work of these bodies. Mr. Marlow was assistant secretary to the Institute of Chemistry from 1919 until 1925.

AN earthquake of unusual violence and long duration occurred in the eastern Mediterranean at about 10 P.M. on June 26. Much damage to property was caused in Crete, and apparently, to a less extent, in Rhodes. The principal shock, as in so many of its predecessors in south-eastern Europe, was felt over a very wide area, from the Ionian Islands and Greece to Cairo and so far east as Jerusalem. The disturbed area cannot be less than 1200 miles long from north-west to south-west, and about 800 miles wide, the total area being about 750,000 square miles. The epicentre was probably near Crete and between that island and Rhodes.

IN view of the enormous amount of scientific and other special information now available in periodicals and libraries, an association—The Association of Special Libraries and Information Bureaux—was formed to assist in making such information available to all who wish to use it. With the assistance of the Carnegie United Kingdom Trust the Association has undertaken, as one of its first activities, the compilation of a directory of sources of specialised information in Great Britain and Ireland. The general editorship of this work has been entrusted to Mr. G. F. Barwick, formerly Keeper of Printed Books at the British Museum.

PROGRESS is being made towards uniformity in the issue of wireless time signals. We learn that the signal from the Cape is now to be brought into line with the modified Onogo system recommended at the meeting of the International Time Commission in July 1925 and issued from the French stations since the beginning of this year. This signal is emitted from the Slangkop Wireless Station and originates at the Royal Observatory, Cape of Good Hope. The change requires the introduction of a new transmitting apparatus, the cost of which is to be defrayed by the Union Government. Multiplicity in the form of time signals is nothing but a disadvantage, and the change will be a great satisfaction to users of the signal and especially to mariners. It is expected to come into operation early in 1927.

THE Royal Sanitary Institute is celebrating its jubilee by holding an Imperial Congress at the Central Hall, Westminster, on July 5-10, under the presidency of the Minister of Health, the Right Hon. Neville Chamberlain. More than 1000 delegates have been appointed to attend by Government Departments,

including and Northern Ireland, the Ministry of Agriculture, H.M. Office of Works, the Home Office, War Office, Board of Control, and the Air Ministry. Many foreign governments, and municipal authorities, learned societies, and universities throughout the United Kingdom will also be represented. In connexion with the celebrations a handbook has been prepared recording the history and activities of the Institute, together with special articles dealing with sanitary progress during the fifty years 1876–1926, from the medical, engineering, architectural, parliamentary, legal, public administration, colonial, military, and naval aspects.

The American Chemical Society, which was founded in 1876, celebrates its fiftieth anniversary in Philadelphia, Pennsylvania, U.S.A., on September 6-11 next. It is anticipated that some 3500 chemists from all parts of the world will be present. The Society will meet in eighteen divisional gatherings, dealing with various branches of pure and applied chemistry. Many of the divisions will hold special symposia of papers and addresses of importance from authorities in their respective fields. In addition, there will be two general meetings of the whole Society. No direct invitations or requests for the appointment of special delegates are being sent out; all non-American chemists are invited to attend and take part in the meeting on the same basis and under the same conditions as members of the Society. Foreign chemists expecting to attend the meeting should, if possible, communicate with Charles L. Parsons, Secretary, Mills Building, Washington, D.C., U.S.A.

The latest catalogue of Messrs. Heffer and Sons, Ltd., Cambridge, (No. 269) is devoted to second-hand books on physiology, anatomy, medicine, zoology, biology, anthropology, and ethnology. Many of the works listed are from the libraries of the late Sir William Bayliss and Sir Francis Darwin. The publishers offer the catalogue free upon application.

Messrs. Watts and Co. are about to reissue, in two volumes, Herbert Spencer's "Autobiography," which for some time has been out-of-print. They have also begun a new cheap series of volumes entitled "The Forum." Among future works will be "The Origin of Life," by Sir Edward Sharpey Schafer, and "The Goodness of Gods," by Dr. E. A. Westermarck.

Messrs. Bernard Quaritch, Ltd., 11 Grafton Street, W.1, have just issued another useful catalogue—No. 400—dealing with some 2000 second-hand works on botany, agriculture, early medicine and surgery, forestry, fruit-culture, gardens and gardening, herbals, modern medicine, and tobacco. It should certainly be seen by all readers interested in these branches of knowledge.

Our Astronomical Column.

The Atmosphere of Mars.—In August 1924 Mr. Wright obtained at the Lick Observatory photographs of Mars in ultra-violet, yellow and red light. The former showed a larger image than the others, but gave scarcely any detail on the planet's surface. B. Fessenkoff, of the Moscow Astrophysical Institution, makes some calculations on the subject in *Astr. Nachr.* No. 5450. He concludes that the observed facts are best satisfied by supposing that the upper layers of the planet's atmosphere contain fine dust which is nearly opaque to ultra-violet light, but transparent to red and yellow light. As to the possibility of fine dust at great heights, reference may be made to the Krakatao eruption of 1883. The dust remained suspended in the upper air for more than a year, causing remarkable sunsets all over the world.

The Polar Compression of Uranus.—An article by C. Wirtz in *Astr. Nach.* No. 5441 gives a new estimate of the oblateness of Uranus by comparison of its brightness at the Uranian equinoxes and solstices. The inclination of the axis is so high that at the solstices, which occurred in 1861 and 1903, the terminator practically coincides with the planet's equator, and the outline appears almost circular; at the equinoxes, which occurred in 1882 and 1924, the poles are on the terminator, the oblateness reaches its maximum and the light a minimum. A discussion of all the available determinations gives the magnitudes as $5{\cdot}46^m$ at maximum, $5{\cdot}67^m$ at minimum. The light-range is concluded to be between $0{\cdot}15^m$ and $0{\cdot}25^m$, from which a compression in the neighbourhood of $\frac{1}{14}$ is deduced. The author concludes that long-continued photometric measures by modern methods would determine the compression more accurately than micrometrical measures of the disc. The range in the values found by the latter method is considerable.

Cepheid Variability.—In an article on the δ-Cephei problem, published in the *Atti della Pontificia Accademia delle Scienze (Nuovi Lincei)*, the Rev. J. G. Hagen, S.J., Director of the Vatican Observatory, deprecates the antagonism which has arisen between the two theories which have been advanced to explain the variability of the light emitted by stars of this type. In some papers, especially those in English, the pulsation theory is referred to as the generally accepted theory, while, in a recent publication of the Ottawa Observatory, it is asserted that the ordinary binary theory may almost certainly be definitely ruled out of court. Such statements are scarcely justified in view of the fact that no clear and precise answer has yet been given to the questions: (1) Where does the impulse for the pulsations come from? And, (2) how are the pulsations maintained uniform for centuries? A natural answer is furnished to both of these queries if a δ-Cephei star is regarded as a binary system; the pulsations would then be periodically excited by the approach of the satellite and would last only from one eruption or light maximum to the next. In this way the mathematical theory of pulsations receives the mechanical basis hitherto lacking, and, moreover, the undulations observed in the descending branches of the light curves find their most obvious explanation. On the other hand, no invincible argument against the presence of a satellite has ever been brought forward. So far as analogy with other celestial phenomena is concerned, there is in the entire heavens no well-proven example of periodic changes due solely to the internal forces of a star, especially now that some long-period variables have revealed themselves as binary systems, whilst striking examples of light eruption are provided by comets approaching the sun.

Research Items.

THE PERUVIAN QUIPUS.—Baron Nordenskiöld continues his study of the quipus, the systematically knotted cords found in Peruvian graves, in the second part of No. 6 of his "Comparative Ethnographical Studies" (Göteborg: Elanders Boktryckeri Aktiebolag). He here follows up his previous suggestion that the quipus have a calendrical significance by a detailed study of seven quipus on a numerical evaluation of the knots according to their position and the colour of the cords. As regards the ancient Peruvian calendar, the statements of early writers are ambiguous and contradictory as to the division of the year into months, the extent to which the distinction between the lunar and solar year was recognised, and the date on which the year began. It is possible that this confusion arose out of the fact that the more intimate and accurate knowledge of the calendar was confined to the priests, with whom the whites were less likely to come into contact, while the common people, from whom these writers obtained their information, used the lunar year; the solar year, divided up into months of thirty days with five intercalary days, being the property of the learned and not in general use everywhere. Certain results common to the quipus here examined are found to emerge from the numerical evaluation. It would appear that the Incas worked with solar years of 365 days and with months of either 29½ or 30 days, the classification of knots according to the colour of the strings producing both results on the same quipus. The number 7 has special significance. The Incas worked both with synodical months and with a division of the year into 12 months of 30 days plus 5 extra days. It is possible that they knew and reckoned with a synodical revolution of Jupiter calculated at 397 days. The results obtained support the statements of the old writers.

STONE IMPLEMENTS FROM NORTH-WEST PERU.—Relics of a remarkable lithic industry found in north-west Peru are figured and described by Mr. C. Barrington Brown in *Man* for June. Flakes apparently made by human agency were first observed in 1911 at Punta Picos, south-west of Tumbez, on the sandy surface of an ancient sea floor now sixty feet above sea-level. They were of the simplest type and of various materials, showing in every case one side as a single fracture. Later similar flakes, with a few showing secondary pressure flaking along an edge, were found at many different sites, on hilltops and slopes, river terraces and plains. In 1924, on the occasion of a second visit to that locality, not only large quantities of flakes, several reworked, were found, but also stone implements of a skilled manufacture, polished axes, mortars, bowls, etc. At the head of a canyon was found a piece of worked slate which may be a phallus. In three places flakes were found with modern Inca remains which may have been due to Inca occupation of ancient sites. So far, finished implements have been found in one locality only. In the majority of cases no pottery fragments, no bones, and no metal were found. The most interesting and important site is that of El Estero, a small pond 22 miles inland due east from Cabo Blanco on the highest point, at an elevation of 85 feet above sea-level, of a low pass through the Buitre hills. Most of the axe-heads and implements were lying on the surface a few yards from the trail. The area of habitation covers about 1000 square yards with an accumulated thickness of reddish-grey earth of about 4 feet. Here thirty-one axe-heads were found, all except one showing a feature unique in axe-heads, the sides and butt being filed down into a flat or slightly concave face. The butts are provided with protuberant ears of unusual shape. Two examples from Ecuador in the British Museum have the protuberant ears but not the typical flattened butt and sides. The absence of pottery suggests a pre-Inca industry.

BIRDS IN SOUTH AMERICA.—Comparatively little is known of the migration of birds in the southern hemisphere, and in order to some extent to repair this blank, A. Wetmore spent ten months in the southern States of South America, particularly to observe North American birds in their winter quarters, and of these more especially the waders. The results of this expedition, which lasted from June 1920 until April 1921, have recently been published (Smithsonian Institution, *United States National Museum Bulletin*, 133, "Observations on the Birds of Argentina, Paraguay, Uruguay, and Chile"). They comprise much more than the main object of the journey, for his travels in Argentina, Paraquay, Uruguay, and Chile brought the author in contact with many native birds, regarding which he has made comprehensive and excellent field notes. The descriptions of several racial forms new to science have already appeared in other scientific publications, but are here repeated. Many valuable notes on migration, a detailed itinerary, a good map, and many excellent photographs of the various types of bird country, add to the interest of this contribution to the knowledge of South American bird life.

THE SOURCE OF HYDROGEN SULPHIDE IN THE BLACK SEA WATERS.—It has long been known that the upper layers of the waters of the Black Sea only are free from hydrogen sulphide, which is present from the depth of 150 metres downwards, so that no life except bacteria is possible between 150 metres and the bottom (2188 m. in the deepest parts). Nothing was known, however, as to the origin of this hydrogen sulphide, and only recently Prof. B. L. Issatchenko has proved that it is produced from the sulphates dissolved in water by anaerobic bacteria similar to *Microspira æstuans*, known from the northern seas. The Black Sea organism is exceedingly active and can produce so much as 0·3 gm. of hydrogen sulphide per litre of water. Apart from this organism, there are in the bottom mud of the Black Sea some other bacteria able to produce hydrogen sulphide from albumins, but their productivity is far lower and the conditions for it in the depth of the sea are less favourable. Another problem investigated by Prof. Issatchenko was why the surface layers of water are free from hydrogen sulphide. This was formerly ascribed to the presence of an intermediate layer populated by bacteria which are able to oxidise hydrogen sulphide produced in the deeper waters. No such bacteria could be found by a systematic sampling of water, and it is concluded that the oxidation of hydrogen sulphide in the upper layers is due simply to the circulation of water (*Priroda*, 1925, Nos. 4-6).

DUSTING BY AEROPLANE AGAINST MOSQUITOES.—Circular 367 of the United States Department of Agriculture is devoted to an account of experiments carried out for testing the possibilities of employing aeroplanes in the control of the breeding of Anopheles mosquitoes. The authors, Messrs. W. V. King and G. H. Bradley, mention that Paris green was distributed from aeroplanes on the extensive marshes and swamps near Mound, Louisiana, in 1923 and

1924. As the Paris green is effective in very small quantities, it was diluted by mixing with an inert carrier, fine silicious earth being mostly used. No special difficulty was experienced in distributing the insecticide over open water or rice fields: the most difficult conditions encountered were in heavily wooded areas where the water was protected by dense foliage. In the latter conditions a larger amount of the arsenical is required as compared with about half a pound per acre in open areas. The two final tests of 1924 gave particularly clear-cut results. In areas overgrown with aquatic vegetation, 88 per cent. to nearly 100 per cent. of the Anopheles larvæ were destroyed. Controls were made by the use of open porcelain pans of water containing ten larvæ each. These were placed at the different stations before the dust was applied by aeroplane, and were examined the following day for the percentage of larvæ killed.

GENETICS OF THE CABBAGE TRIBE.—The cabbage tribe forms an interesting variation group. All the forms of cabbage, kale, kohl rabi, brussels sprouts, broccoli and cauliflower, are believed to have been derived from the wild *Brassica oleracea* found on various European coasts, for example, on the cliffs at Dover. The ancient Greeks recognised three varieties. The others have appeared since, but little is known as to how or when. Mr. M. S. Pease (*Journ. Genetics*, vol. 16, No. 3) is making a genetical study from crosses of savoy, kale, and kohl rabi. Kale is found to have two independent factors, in the absence of which the cabbage heart develops, one factor giving an intermediate condition. Malinowski found three polymeric factors for heart in certain other cabbages. The heart factor also shows linkage with a number of others, and some of these linkages, as of curly leaf with heart, are of peculiar character, showing a strict association between degrees of hearting and degrees of smoothness. Although there is difficulty in classifying degrees of hearting, Pease obtained consistent results by growing the F_3 and F_4 and back-crossing. A peculiar monstrosity (*Asparagodes*) in which leafy outgrowths occur on the midribs of the leaves, was first described in Gerarde's "Herbal," but is believed to be as old as the Greeks. It behaves as a simple dominant in crosses. Another independent factor gives the difference between the purple and green types. Pease distinguishes in addition two linkage groups, one containing a factor (*a*) for heart, (*b*) for tallness, and (*c*) for curliness of leaves. The other group contains the other hearting factor as well as factors for petioles, lyrate leaves, and broad leaves. Thus four linkage groups have already been recognised, while the number of chromosome pairs is nine. Difficulties of observation arise from the fact that the multiple factors frequently give an apparently continuous series of variations, and self-sterility is also involved.

UNUSUAL FORMS OF FOSSIL CRINOIDS.—Among the unusual forms of crinoids described by F. Springer (*Proc. U.S. National Museum*, vol. 67, art. 9, 1926) are those in which the stem loses its characteristic shape, becomes coiled, and the columnals (stem plates) are flattened or concave at the inner side and consequently crescentic or elliptical in cross-section; the cirri, instead of occurring in whorls around the stem, are borne only in two rows at the flattened or concave side. In such crinoids there is a tendency for the crown to bend back upon the stem, and for the stem to coil around it in the opposite direction in such a way that the crown may be tightly enclosed within the coil and completely enveloped by the cirri. This character, which was evidently protective, originated independently in a number of unrelated genera ranging from the Silurian to the Carboniferous. Other crinoids are described with the arms in a recumbent position instead of being outstretched or folded together as is the case with existing forms; in these the arms were normally pendent, with the dorsal side pressing backward upon the calyx and stem.

THE DEPTH OF ORIGIN OF EARTHQUAKES.—More than any other living man Mr. R. D. Oldham has helped to bring the science of seismology to its present vigorous state, and his latest contribution to the subject is, like most of his work, of fundamental importance. Dealing with *episeisms* (surface shocks) as opposed to *bathyseisms* (deep-seated shocks), Mr. Oldham shows that the depth of origin can be calculated from an empirical formula based on the intensities at a point directly above the disturbance and at another distant point (*Q.J. Geol. Soc.*, vol. 82, 1926, p. 67; and *The Observatory*, March 1926, p. 86). Loss of energy by absorption is allowed for from a study of earthquakes that have been worked out in great detail. Applying the formula to 5605 Italian shocks that occurred between the years 1897 and 1910, he finds that 90 per cent. originated at depths of less than 8 km.; and only 1 per cent. gave a depth greater than 30 km. From the long-distance records of bathyseisms, Prof. Turner has found that most of these disturbances originate at a depth of about 200 km., with smaller proportions at about 100 km. and 500 km. Fracturing of the rocks of the outer crust is by far the most probable cause of the surface shocks, but this explanation is out of the question for bathyseisms. Changes of state accompanied by changes of bulk might cause the long-distance earthquakes and at the same time fracture the surface rocks, thus leading to a nearly simultaneous episeism. The San Francisco earthquake was a compound phenomenon of this kind. The local effects indicated a depth of 20 km., while the long-distance records gave 140 km. Seismology thus becomes the study of two very different types of earthquakes.

GEOLOGICAL TIME.—In the *Phil. Mag.* for May 1926, pp. 1055-74, Dr. Arthur Holmes gives a review of all the evidence in favour of the longer estimates of geological time which have been based on lead-ratios. The adverse criticisms by Prof. Joly are shown to be founded either on faulty data, or on speculations that are not necessarily true. The sodium method is rejected on grounds already reviewed in NATURE (April 24, p. 592). It is suggested that the discrepancies in thorium minerals are due to the fact that lead present as oxide or silicate would be more easily removed by percolating waters than the lead in uranium minerals, which is most probably present as a highly insoluble uranate. An analysis of atomic weight determinations on lead from thorium minerals supports this conclusion, and shows further that there can be very little actinium D in 'uranium lead.' Thus the ages calculated from the lead-ratios of uranium minerals, if they are otherwise free from suspicion, cannot be more than a few per cent. too high. The variation in the radii of uranium haloes is shown to be explicable by other hypotheses besides that advocated by Joly, so that no evidence is valid along this line of attack until the istopic constitution of 'uranium' has been revealed. It is concluded that the time elapsed since the crystallisation of the middle pre-Cambrian pegmatite-minerals of Norway, Sweden, Texas, Ontario and Africa is of the order of 1000 million years. No higher ages are yet well established, though the age of the oldest rocks must, of course, be considerably greater than these of the middle pre-Cambrian.

Rate of Aeration of Water.—W. E. Adeney has published a series of observations in which he has determined the rates of solution of oxygen, expressed in percentages of saturation, by films of de-aerated fresh, or salt waters, 0·05 cm. thick, when uniformly exposed to the air, and independent of evaporation and downward streaming ("On the Rate and Mechanism of the Aeration of Water under Open-air Conditions," *Sci. Proc. Roy. Dublin Soc.*, 18 (No. 20), 211-217, April 1926). This has been followed by determinations of the rate of solution by quiescent columns of water. Owing to the cooling produced by evaporation, minute streamlets sink towards the bottom. In the case of salt water, density changes also assist the mixing. Movements occurring at the surface facilitate the saturation of the water with gas. Quantitative results are given for certain limiting cases, and suggestions made as to the probable values under various intermediate conditions.

Spectra of Exploded Metals.—In the *Scientific Papers of the Institute of Physical and Chemical Research*, Tokyo, vol. 4, No. 48, T. Hori describes some interesting experiments on the spectra of exploded metals by the method of Anderson. A thread of mercury contained in a fine capillary tube, when exploded in that way, gave a good continuous spectrum crossed by some absorption lines of mercury. Other metals gave a less satisfactory continuous background, but when exploded in the form of fine tubes containing mercury, many absorption lines were seen on the continuous spectrum produced by the mercury. Under reduced pressure the Swan spectrum appeared in absorption by this process, owing to the presence of oil in the explosion chamber. A satisfactory substitute for mercury as the source of the continuous background was found in incandescent carbon particles produced by placing asbestos fibre saturated with petroleum at the exploding centre. Several absorption spectra—including bands of compounds and series and non-series lines of elements—were produced by this device. In the same volume (No. 56) Messrs. Fukuda, Kuyama and Uchida record the appearance of several lines, forbidden by the spectroscopic selection rules, in the spectra of constricted arcs *in vacuo*, while Fukuda, in No. 55, records the production of similar lines in vacuum tubes carrying heavy discharges.

Carbon Tetrafluoride.—In the issue dated May 31 of the *C. R. Acad. Sci.*, Paris, Messrs. P. Lebeau and A. Damiens give an account of the preparation and properties of carbon tetrafluoride, CF_4, from which it would appear that the compounds previously described under that name were far from pure. By the direct action of fluorine on various forms of carbon and passing the products of the reaction through a vessel cooled with liquid air, a colourless liquid is obtained which, from its varying boiling-point, is obviously a mixture. The most abundant constituent of this mixture was isolated by repeated fractional distillation and was found to boil at about $-150°$ C. The gas is odourless and without action on water, is not attacked by aqueous or by alcoholic potash (differing from the gas hitherto described as carbon tetrafluoride by Moissan and by Chabrié), and is not even attacked by fused potash at 740° C. Its composition was established by the reaction with sodium heated to 500° C., which is according to the equation $CF_4 + 4Na = C + 4NaF$. It also reacts with metallic calcium at about 700° C., giving calcium fluoride, calcium carbide, and carbon. A repetition of the work of Chabrié has established that the substance described by him as carbon tetrafluoride was a mixture, the principal constituent of which was a fluochloride, CCl_2F_2.

Propagation of Radio Waves.—Radio engineers are making strenuous endeavours to understand the mechanism of radio transmission. The Radio Corporation of America and its associated companies are making systematic researches, both theoretical and experimental, to discover this mechanism. They admit that electric currents in wires, in a vacuum and in electrolytes, can be explained by means of the electron, but the structure of the electromagnetic field still remains a mystery. Each new discovery in long-wave and short-wave propagation is eagerly studied with this end in view. This is shown in the paper read by E. F. W. Alexanderson on radio wave propagation to the Academy of Swedish Engineers in July of last year. After describing the various phenomena generally referred to as 'fading,' he divides the waves sent out from a radio station into the earth-bound wave, which is guided by the proximity of the conducting earth, and the space wave or high angle radiation, which is guided by refraction in an ionised layer in the upper atmosphere. Long-wave telegraphy depends mainly upon the earth wave. Short-wave long distance communication depends entirely upon the space wave. Broadcast reception depends upon the earth-bound wave for near stations, and on the space wave for distant stations. It is stated that at a distance of about 100 miles from the station the intensities of the two waves are nearly equal. It has been found that at a distance of ten miles from a fifty-metre station the plane of polarisation of the space wave has been twisted by between 20° and 30°. It follows that at some distance between 60 and 90 miles the twist would be 180°. The earth-bound wave maintains its vertical plane of polarisation; the two waves, therefore, may cancel one another at a distance of about 100 miles. This explains 'blind' spots. As a model of radio transmission, he discusses the motion of a horizontal rubber sheet actuated by a vertical shaft making rotatory oscillations. Straight lines drawn on the rubber sheet will appear to have a wave motion. In order to reconcile the old and new points of view he thinks it necessary to prove that the electron is an entity with an aurora reaching from it into infinite space.

A New Reflex Camera.—Reflex cameras possess many advantages, particularly in regard to instantaneous photography, over those of the ordinary type. The 'Press' reflex camera recently placed on the market by Messrs. J. H. Dallmeyer, Ltd., 31 Mortimer Street, London, W.1, should help, in large measure, to meet the demand for an instrument of this type at a reasonable price. We have examined one of these cameras, and find it a serviceable and well-made instrument, easy to manipulate, and capable of giving excellent results. It is fitted with a single wind, self-capping, focal-plane shutter, giving speeds from $\frac{1}{15}$th to $\frac{1}{1000}$th of a second and capable of adjustment for time exposures. The shutter runs very close to the plate, and is smooth and easy in action. The hood is detachable and can be fixed at right angles to its normal position. The reversing back is fitted with a hooded focussing screen, which can be used when the camera is mounted on a stand and critical focussing is required. Sufficient extension is provided to enable objects at a distance of about 18 in. to be brought into focus. The camera can thus be employed for photographic work in the laboratory. The outstanding feature of the equipment is the Dallmeyer 6 in. focus, f/3·5, anastigmatic lens, which gives excellent definition over the whole field. Its large aperture makes it extremely useful for very short exposures, as in certain types of Nature photographs, or for indoor and other work under restricted lighting conditions.

Explosions in Gaseous Media.

A GENERAL discussion on different aspects of explosions in gaseous mixtures took place at a meeting of the Faraday Society held on June 14 at the Institution of Mechanical Engineers, Westminster. The afternoon session, presided over by Prof. H. B. Dixon, was devoted to the consideration of explosions viewed quite generally. In an introductory survey of the subject, Dr. Garner pointed out the large number of factors which have to be considered. The rate of travel of a flame in a gaseous mixture appears to be intimately connected with the amount of preheating—probably by radiation from the flame-front—and with the thermal conductivity of the mixture. It is probable that catalysis also plays an important part in the spread of flame, and a number of substances were mentioned which can be regarded as positive and negative catalysts respectively. Dr. Garner described a possible mechanism which he termed energo-thermal catalysis.

The ignition temperatures of gas mixtures are very important both from the academic and the practical points of view; Prof. Dixon described recent results which he in conjunction with Messrs. Harwood and Higgins had obtained. Using the concentric-tube method, the temperature to which the furnace must be heated before ignition of the gas mixture takes place is dependent upon the time the hot gases are allowed to remain in contact; the true ignition temperature is taken as being that at which the gases unite immediately after mixing. There appears to be a crucial pressure for each gas at which the ignition point is highest; above and below this pressure the ignition point falls. Using the method of adiabatic compression, comparisons were made between the results obtained with two different pieces of apparatus in which the rates of compression were not identical; the lag between the completion of the piston stroke and the recoil due to explosion is shortest when the compressions are highest.

Methods of measurement of the radiation emitted during explosions in closed vessels were described by Prof. David. The infra-red radiation in coal-gas air explosions is at a maximum during the explosion period and before the mean gas temperature attains its maximum value; it is assumed that the radiation is therefore mainly due to chemical activity and not simply to temperature. The introduction of infra-red radiation can speed up the combination in a closed vessel provided that (1) the radiation is of the kind which is absorbed by the combustible gas; (2) nitrogen is present as a constituent of the inflammable mixture; and (3) the mixture composition is such as to be favourable to the formation of oxides of nitrogen during combustion. In the discussion, Mr. Finlayson suggested that the shape of the explosion vessel might have an important effect upon the results obtained, and Dr. Ellis showed some interesting photographs of the mode of flame propagation in closed vessels of different shapes.

The subject of ionisation in gas explosions was introduced by Dr. Garner and Dr. Saunders. It was pointed out that the results obtained by different investigators are not in entire agreement, but the following tentative conclusions can be drawn: (1) The ionisation occurring in gas explosions is mainly thermal, although certain experiments seem to indicate that a small fraction is due to chemical change. (2) Ionisation plays no part in the ignition of gases. (3) It appears unlikely that the ionisation of the gas in front of the explosion is the cause of the propagation of the detonation wave. (4) The action of anti-knocks and knock inducers in the petrol engine cannot be explained on the theory that these substances change the ionisation in the explosion wave. Similar views were expressed in a communication from Dr. Lind.

The importance and the applicability of rates of flame propagation were discussed by Dr. Payman in presenting the results of experiments by Prof. Wheeler and himself. The conditions of flame propagation under which the 'law of speeds' has been found to hold were considered, and it was pointed out that from this law it is possible to calculate the speed of uniform movement in any mixture with air of an industrial gas, the speed of uniform movement of the individual gases with air being known. In the discussion on this paper the point was raised whether the speed of uniform movement could truly be regarded as a physical constant. A short account of recent experiments in Prof. Bone's laboratory was given by Dr. Fraser, and photographs were exhibited showing the movement of the flame in carbon-monoxide-oxygen mixtures. Prof. Jorissen contributed to the discussion some remarks on the limits of inflammability of gases.

The rates of detonation of cyanogen-oxygen mixtures were dealt with in a paper by Dr. Campbell and Prof. Dixon. The detonation velocities in the rapid mixtures appear to be almost independent of the diameter of the containing tube. This is not the case with mixtures largely diluted with nitrogen; in the most highly diluted, the detonation wave is probably never established. From the velocities in the rapid mixtures the mean specific heats of mixtures of carbon monoxide and nitrogen at high temperatures have been calculated.

At the evening session, under the chairmanship of Sir Dugald Clerk, explosive reactions were considered in reference to internal combustion engines. In a brief introduction Sir Dugald Clerk reviewed the work on this branch of the subject carried out by himself and others during the last fifty years. Prof. David discussed the extent to which incomplete combustion of the charge is responsible for limiting the pressures developed in gas engines; about 10 per cent. of coal-gas remains unburnt at the moment of maximum pressure. Various factors which may affect the rate of combustion in gas engines were touched upon. The greater the degree of turbulence of the gaseous charge the more rapidly will inflammation spread; the temperature of the gas engine charge appears to have only a slight effect on the rate of inflammation, but it seems possible that the radiation from the cylinder walls may exert an appreciable influence.

From his experiments with petrol engines Mr. Tizard advanced the view that the dissociation of carbon dioxide at the temperatures reached is sufficient to account for the important fact that maximum power first occurs with slightly 'rich' mixtures and remains practically constant over a considerable range in strength of mixture. In regard to the possibility of detonation of a 'pure' fuel, this appears to depend upon whether a certain temperature, characteristic of the substance, can be exceeded. Anything which lowers the maximum temperature reached during the explosion will tend to stop detonation. The view was put forward by Messrs. Sims and Mardles that metallic anti-knock compounds suffer thermal decomposition, and that the colloidal metal so produced brings about a decrease in volume of the unburnt charge ahead of the flame. Easily oxidisable metals like lead, nickel and iron give positive results as anti-knock compounds, whilst silver and gold are not effectual. Prof. Dixon, Prof. Marks, Messrs. Finlayson, Kay, Sutton, Whatmough and others, contributed to the discussion.

C. C.

The Eastman Universal Colorimeter.

THE Eastman Kodak Company, of Rochester, N.Y., U.S.A., has placed on the market a very useful colorimeter (Fig. 1) which has a greater range of utility than many other instruments of this kind. Originally designed by L. A. Jones (*Journal of Optical Soc. America*, 4, 420, 1920) for use in connexion with war-time problems of visibility and the measurement of the colours of sea and sky, it has been adapted, by the addition of various accessories, for the majority of laboratory and industrial requirements.

The fundamental basis of its action is the phenomenon of the so-called "subtractive colour mixture."

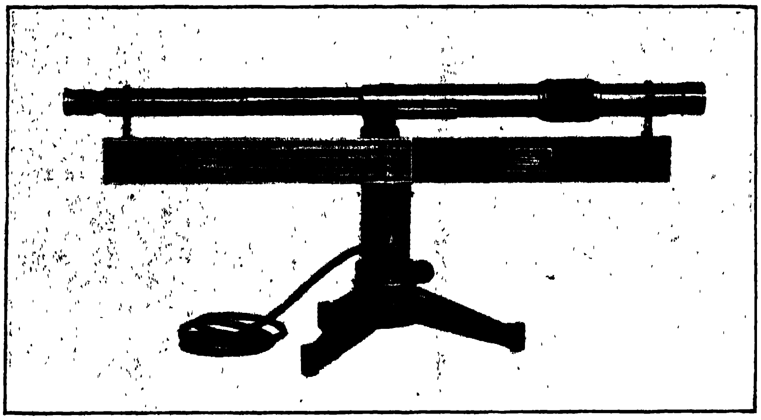

FIG. 1.—The Eastman colorimeter.

To illustrate this we may imagine three colour filters for which, in turn, the main absorption is in the red, green, and blue parts of the spectrum; thus the filters will appear blue-green, magenta, and yellow, respectively. It will easily be understood that by using these in pairs, the primary colours red, green, and blue may be produced in the transmitted light.

For the purposes of the colorimeter these subtractive primaries (blue-green, magenta, and yellow colour filters) are used in the form of long and thin wedges of dyed gelatine, suitably mounted so that various thicknesses of the absorbing medium can be introduced into the light beam by sliding the wedge parallel to its own length. By this means it is possible, for example, to 'mix' varying amounts of yellow with blue-green in order to obtain a series of greens varying from blue green to yellow green, and so on; the use of all three wedges in considerable thicknesses will produce the darker colours. A neutral wedge and supplementary colour filters are added to increase the colour range, which includes all hues and saturations up to high values. Only some of the most highly saturated colours cannot be matched, such as, for example, a very strong emerald green.

The colorimeter is so built that light derived from a standard electric lamp and passing through the wedges illuminates one half of the field of view, while the other half is illuminated by light from the object under test. Thus the colours of objects may be measured *in situ*, or samples may be specially mounted and illuminated for examination in the fittings which are provided; these include one designed for opaque objects, another for colour filters, and another which is designed to intensify the hue component in colours of low saturation by the use of multiple reflections from the coloured surface.

The colour scale is necessarily arbitrary, but it is claimed that an adequate permanency of the wedges has been secured, so that the instrument as it stands should be of utility for such industrial purposes as the standardisation of paints in manufacture and the like, but it is not easy to judge how far the scales of separate instruments of this kind would agree.

In order to convert the readings of the instrument into the usual colorimetric terms of 'hue, saturation, and brightness,' a special calibration of the wedges would be necessary; the accurate transformation would always be a somewhat cumbersome process, though time could be saved by suitable tables and graphical methods.

The instrument is well made and finished, and is very simple in operation. Provided that the difficulty of dealing with highly saturated colours is borne in mind, it should meet the needs of many who have to make colorimetric measurements. L. C. M.

The World's Forestry Congress.

THE World's Forestry Congress was held at Rome on April 29-May 5. The meeting was preceded by a visit on April 27 to the Milan Exhibition, at which a certain number of delegates inspected the forestry exhibit and a section dealing with wood-utilising machinery. Fifty-eight countries were represented at the Congress, most having from two to five Government delegates and a varying number of others who represented their countries but were not specially deputed to do so. Most of the European countries had strong deputations, as also had the United States of America. The heads of the delegations representing Great Britain and the Government of India respectively were Lord Lovat and Prof. E. P. Stebbing.

At a preliminary meeting of the Technical and Scientific Committee on April 28, the honorary presidents, president, and vice-president of the Congress were elected, and afterwards the presidents and vice-presidents of the five sections into which the Congress was divided for working purposes. The presidents of the Congress were Italians. The vice-presidents were from Germany, United States, Great Britain, Dutch East Indies, Japan, and Norway, and the presidents of sections from Sweden, Czechoslovakia, Spain, France, and Brazil.

The opening meeting of the Congress was held on April 29, H.M. the King of Italy and M. Mussolini being present. This was followed by a general meeting, and later by a meeting of heads of delegations at which the work to be carried out was finally sanctioned. Two days, May 31 and June 1, were devoted to a visit to the Forest School at Florence, and to an excursion to the forest of Vallombrosa. Three days were allowed for the work of the sections, each section having three meetings of three hours each. Sections I. and III. met at the same hours, and sections II., IV. A and IV. B. It was not therefore possible for any one delegate to attend all the meetings of each section. Since many Governments were well

represented this would have been immaterial had the agenda of each section been confined to well-defined branches of forestry. Unfortunately, however, there was a certain amount of overlapping, and this proved somewhat of a hardship. Some transfers of subjects were made between sections, at the request of presidents and vice-presidents. It became inevitable, but proved rather confusing for the rank and file of the delegations.

Briefly, Section I. confined itself to questions dealing with forestry statistics, policy, economics, legislation and instruction in sylviculture; Section II., trade and industry in timber, and in forest products in general; Section III., technical problems relating to sylviculture and forest management; Section IV, A, control of torrents, reafforestation of mountain areas, plant diseases and wind damage, forestry propaganda and improvement of game and fisheries; Section IV, B, tropical forestry resources, sylviculture, protection and management and research in tropical forests, uses and export of tropical timbers. Resolutions on these matters were passed by each section and were accepted at the final general meeting of the Congress on May 5.

Linguistic difficulties were of course a great trouble, and resulted in an enormous waste of time. The languages declared for use were French, English, German, Italian and Spanish. The last two were given up at the outset. French was the language used from the chair at all meetings, and was the language (with English) used in the daily reports of agenda, etc., issued during the meeting. But translations into English or German had constantly to be made during the meetings. It is obvious that a certain responsibility rests on Governments in this matter, and that however eminent a man may be in his own branch of study, he loses the greater part of his utility to his Government, and wastes the time of an International Congress, if he can only speak his own language.

Some 247 papers were presented to the Congress, a proportion only being read in précis form. That the Rome Congress was a success is beyond doubt. A careful study of the proceedings will show that work of a very valuable character was accomplished, which should prove of use to the Governments of the various countries which have forest areas of importance to conserve.

University and Educational Intelligence.

CAMBRIDGE.—Mrs. Pilcher, sister of the late Prof Lewis, has offered her brother's house, 2 Fitzwilliam Road, to the University in accordance with his wishes. The rent is to be devoted to the Mineralogical Museum, particularly to the purchase of specimens and books.

Mr. A. J. Dorward, Trinity College, has been appointed University lecturer in moral science. Dr. Cobbett, Trinity College, has been re-appointed University lecturer in pathology. Mr. A. Hutchinson, Pembroke College, has been elected professor of mineralogy in succession to Prof. Lewis, who died on April 16 last.

The Council of Trinity College is inviting applications from Bachelors of Arts, or those admitted to the title of a degree, for a Rouse Ball travelling studentship in mathematics, the purpose of which is to enable the student to study mathematics or the application of mathematics in a foreign university or school.

The Master and Fellows of Pembroke College announce that they will shortly make an election to a Stokes Studentship for research in physics or subjects cognate thereto. The value of the studentship is between 400*l.* and 450*l.* a year, and the tenure will be for three years with the possibility of renewal for a further period not exceeding five years. Candidates may be of either sex and must be between 23 and 30 years of age. They must have shown capacity for research in mathematical or experimental physics or in subjects cognate thereto, such as physical chemistry or the study of physical laws in relation to living matter. Preference will be given to graduates of the University of Cambridge.

The Henry P. Davison scholarships have been awarded to F. P. R. Howard, Trinity College, A. Macdonald, St. John's College, and C. D. G. Nicholson, Jesus College. The scholars will proceed to Harvard, Yale, and Princeton Universities respectively.

GLASGOW.—At the graduation ceremony on Wednesday, June 23, busts of the late Sir William Macewen were presented to the University and to Lady Macewen.

The following were presented for the degree of Doctor of Science (D.Sc.): Mr. R. V. Hansford, for a thesis entitled "A Description of a High Frequency Generator utilising Thermionic Valves and forming part of a Modern High-Power Radio-Transmitting Station," with additional papers; Mr. J. P. M'Hutchison, for a thesis entitled "Researches in Radioactivity with the Radio-Elements Radium D and Radium E."

LONDON.—Mr. Justice Tomlin (chairman), Sir Amherst Selby-Bigge, Sir Cyril Cobb, Sir Josiah Stamp, Sir Cooper Perry, Mr. A. D. Lindsay, Miss Bertha S. Philpotts, and Prof. T. P. Nunn are, according to the University of London Bill recently introduced in the House of Lords by Lord Balfour, to be the first Commissioners of the University of London.

Sir William Beveridge, Director of the London School of Economics, has been elected Vice-Chancellor for 1926-27 in succession to Prof. E. A. Gardner.

Mr. W. C. Clinton has been appointed as from August 1 to the University chair of electrical engineering tenable at University College. Mr. Clinton was educated at the Central Foundation School, the Technical College, Finsbury, and the City and Guilds College. In 1894 he was appointed assistant in the Electrical Engineering Department at University College, and since 1907 has been assistant professor of electrical engineering. His published work includes "Electric Wiring," "The Science of Illumination" (translated and modified from the German of Dr. L. Bloch); and numerous articles in the *Proc. Phys. Soc.*, *Phil. Mag.*, and other scientific and technical papers.

Mr. P. A. Buxton has been appointed as from August 1 to the University readership in medical entomology tenable at the London School of Hygiene and Tropical Medicine. Mr. Buxton was a fellow of Trinity College for the period 1916-21. In 1921-24 he was medical entomologist to the Palestine Government, and in 1924-25 leader of the expedition from the School of Tropical Medicine to the South Pacific. Since March last he has been Director of the Department of Medical Entomology at the London School of Hygiene and Tropical Medicine. He has published a book entitled "Animal Life in Deserts" (London, 1923), and numerous articles in scientific journals.

The title of reader in pharmacognosy in the University has been conferred on Mr. T. E. Wallis, in respect of the post held by him at the School of Pharmacy. Mr. Wallis was educated at Owen's School, Islington (1885-1892), and Birkbeck and King's Colleges (1899-1900). His published work includes "Analytical Microscopy, its Aims and Methods," "Botany: an Outline of Classification" and "Practical Pharmacognosy."

Prof. A. J. Clark, who occupied the University chair of pharmacology at University College, has resigned on his appointment to the chair of materia medica in the University of Edinburgh; Dr. G. V. Anrep has resigned from the University readership in physiology tenable at the same College, on his appointment as lecturer in physiology in the University of Cambridge.

Mr. Major Greenwood has been appointed as from August 1 to the University chair of epidemiology and vital statistics tenable at the London School of Hygiene and Tropical Medicine. The title of reader in medical statistics was conferred on Mr. Greenwood in January 1915 in respect of the post held by him at the Lister Institute of Preventive Medicine. He was Milroy lecturer at the Royal College of Physicians in 1922, and is honorary secretary of the Royal Statistical Society and of the Section of Epidemiology of the Royal Society of Medicine. He has published a number of papers on medical statistics and industrial medicine.

Prof. W. W. C. Topley has been appointed as from August 1 to the University chair of bacteriology and immunology tenable at the London School of Hygiene and Tropical Medicine. Prof. Topley was educated at St. Thomas's Hospital and the University of Cambridge. He was director of the Institute of Pathology at Charing Cross Hospital (1911–22), and since 1922 he has been professor of bacteriology in the University of Manchester and director of the Public Health Laboratories. In 1919 he was Goulstonian lecturer to the Royal College of Physicians, and in March last he delivered the Milroy lectures in experimental epidemiology there. He has published numerous papers dealing with bacteriology, epidemiology, and immunology.

The degree of *D.Sc.* in botany has been conferred on Miss M. H. Carré, the Imperial College (Royal College of Science) and Bedford College, for a thesis entitled "Chemical Studies in the Physiology of Apples."

St. Andrews.—The University Court has appointed Mr. A. D. Peacock, senior lecturer in zoology at Armstrong College, Newcastle-on-Tyne, in the University of Durham, to the vacant chair of natural history in University College, Dundee. Mr. Peacock's experience in the teaching of zoology and in research work, chiefly in entomology, extends from 1909 to the present time, that period being broken by service as an entomologist in the Government Agricultural Department of Southern Nigeria and by military service from 1914 until 1919, when his entomological knowledge was made use of for research and instruction in the Medical and Sanitary Services under the War Office. In this department of investigation he has published many valuable scientific papers. Miss Edith Philip Smith has been appointed to the lectureship in botany in University College, Dundee. Miss Smith, who studied botany at Edinburgh, Oxford, and Harvard, was a lecturer in botany in King's College, London, and has for the past four years been demonstrator in botany in the University of Edinburgh. Her publications include a number of papers embodying the results of research, chiefly in plant physiology. Mr. A. O. Adamson having vacated the post of assistant in natural history in the United College, St. Andrews, on his having been awarded a Commonwealth Research Scholarship, Miss Christina H. Sutherland has been appointed to succeed him.

Dr. H. H. Hodgson has been appointed head of the combined departments of colour chemistry and general chemistry at the Huddersfield Technical College.

Contemporary Birthdays.

July 2, 1862. Sir William H. Bragg, K.B.E., F.R.S.
July 4, 1848. Lord Sydenham, G.B.E., F.R.S.
July 5, 1862. Prof. G. H. F. Nuttall, F.R.S.
July 6, 1857. Sir Hercules Read, F.S.A.
July 6, 1865. Sir Hugh K. Anderson, F.R.S.
July 6, 1873. Mr. Sidney George Brown, F.R.S.
July 8, 1861. Prof. J. Arthur Thomson.

Sir William Bragg, who succeeded the late Sir James Dewar as Fullerian professor of chemistry in the Royal Institution, was born at Westward, Cumberland. Educated at Market Harborough Grammar School, and King William's College, Isle of Man, he graduated at Trinity College, Cambridge, in 1884 as third wrangler. His mathematical studies had been pursued under the guidance of Dr. E. J. Routh. Elected in 1885 to the chair of mathematics and physics in the University of Adelaide, he returned to England in 1908 to take up the professorship of physics in the University of Leeds, transferring, in 1915, to a similar chair in University College, London. In that year Sir William was allotted the Nobel prize for physics, jointly with his son, Prof. W. L. Bragg, for their services in promoting the investigation of crystal structure by means of X-rays. The Royal Society awarded its Rumford medal in 1916 to Sir William, on the ground of his researches in X-ray radiation.

Lord Sydenham, Governor of Victoria from 1901 until 1904, is of Lincolnshire extraction, and he was educated at Haileybury and the Royal Military Academy. Entering the Royal Engineers branch in 1868, he participated in the 'eighties in much active service. Lord Sydenham was president of the British Science Guild in 1917–20.

Prof. Nuttall was born in San Francisco. Since 1906 he has been Quick professor of biology in the University of Cambridge. He has written many memoirs concerning bacteriology, entomology, parasitology, and hygiene.

Sir Hercules Read engaged early in the service of the British Museum, under the inspiring influence of Sir Augustus Franks. He became keeper of British and medieval antiquities and ethnography in 1896, retiring in 1921. Sir Hercules has been twice president of the Society of Antiquaries, namely, for the period 1908–14, and again 1919–24. He is Hon. LL.D. Edin.

Sir Hugh Anderson was born at Hampstead. Educated at Harrow, Cambridge, and, for his medical studies, at St. Bartholomew's Hospital, he has been, since 1912, Master of Gonville and Caius College, Cambridge.

Mr. Sidney Brown, electrical engineer, was born at Chicago, but he is of English parentage. He was educated at Harrogate College, and University College, London. Mr. Brown is responsible for many very ingenious inventions applicable to submarine cables, telephones, airships, aeroplanes, and radio, and also of a gyroscopic compass. He is the author of a number of original contributions to science.

Prof. J. Arthur Thomson was born in East Lothian, and he was educated at the Universities of Edinburgh, Jena, and Berlin. Since 1899 he has been Regius professor of natural history in the University of Aberdeen. He was Terry lecturer at Yale in 1924. Prof. Thomson has written many books on natural history subjects, which have a wide vogue. He is Hon. LL.D. Edin.

Societies and Academies.

LONDON.

Royal Society, June 24.—J. C. **McLennan** and A. B. **McLay**: On the structure of the arc spectrum of gold.—Nearly all the wave-lengths known to belong to the gold arc-spectrum have been classified. The most important wave-lengths not yet classified are six that were found to be absorbed by the vapour in the under-water spark of gold. These wave-lengths undoubtedly involve the metastable term $1D_3^2$. Zeeman-effect experiments will probably furnish the best means of definitely settling any features of the arc-spectrum of gold not yet clear.

J. C. **McLennan** and H. G. **Smith**: On the series spectra of palladium.—The regular arc-spectrum of palladium, involving disturbances of a single electron outside a core of nine 4_3 electrons, includes very nearly all the strong lines of the arc, and most of the faint lines of wave-length longer than 3400 Å.U. In the region of shorter wave-lengths there is also a large number of faint lines, apparently belonging to the arc-spectrum, for which no place can be found in the regular series system. These faint lines can probably be ascribed to a secondary-series system. The analysis of the spark-spectrum has shown that $(4_3)^8\ 5_1$ and $(4_3)^9$ are of almost equal stability, and consequently terms of this type should occur with considerable prominence in the arc-spectrum, but might not combine readily with the regular terms. An attempt to find a clue to this part of the spectrum by means of the inter-combinations has been unsuccessful. Similar configurations are also likely to be prominent in the spark-spectrum.

A. M. **Tyndall** and L. R. **Phillips**: The mobility of ions in air (Part iii.).—Measurements of the mobilities in air containing organic vapours over a range of concentration extending up to saturation show in every case a reduction in mobility by the addition of vapour, though the amount depends upon the constitution of the vapour and the sign of the ion. The gradient of the mobility vapour pressure curve for the negative ion is in general steep at low concentrations, but falls off later. In the case of the homologous series of normal aliphatic alcohols the steepness increases as one ascends the series. Similar effects have been observed for the positive ion, but the initial drop in mobility is much less marked. The relative effects of the various vapours seem to depend upon (1) a 'clustering coefficient' determined by the combined effect of any permanent electric moment and an induced electric moment in the neutral molecule, (2) the effective diameter of the cluster.

L. C. **Jackson**: Investigations on paramagnetism at low temperatures (Part ii.).—Orientated sections of the crystal are suspended in a non-homogeneous magnetic field and the forces exerted on them are measured by means of a Pettersson quartz micro-balance sensitive to 10^{-6} mgm. The magnetic field is produced by a large accurately constructed coil and its value is determined from the current strength and the coil dimensions. Data for the three principal susceptibilities of cobalt potassium sulphate are given for temperatures down to $-100°$ C. The principal susceptibility parallel to the symmetry axis of the crystal is also given for nickel ammonium sulphate and manganese ammonium sulphate. The principal susceptibilities all obey the law $\chi(T+\Delta) = \text{constant}$ over the range of temperature investigated.

Sybil **Cooper** and D. **Denny-Brown**: Responses to rhythmical stimulation of the cerebral cortex.—Electrical and myographic records have been made of movement produced by rhythmical stimulation of the cerebral motor cortex. Rates of 18 to 68 per second were used. In the electromyograms the primary waves follow the rate of stimulation, and secondary waves are at present giving an average total frequency of 120 per sec. The mechanical records show rhythmic tremor corresponding in frequency with rates of electrical stimuli applied to cerebral cortex, even at 68 per sec. This confirms, and extends, to higher frequencies, the original observations of François-Franck and Pitres.

Karl **Pearson**: Researches on the mode of distribution of the constants of samples taken at random from a bivariate normal population.—This paper deals with the distribution in samples, regardless of their size, taken from a large normal population of some of their 'compound' constants By compound constants is meant not simple constants like means, standard deviations, or coefficients of correlation, but functions of these constants. The actual curves of distribution of the standard deviations of arrays, and of the regression coefficient are obtained. Also the distribution of the means of arrays as determined by the regression line of the sample is studied, and all the moments of this distribution are determined, but it has not been possible to determine its curve of distribution. Even when sampling from a normal population, the curves of distribution of compound constants (like those of the majority of simple constants) are not themselves normal, nor are the relations between them linear. It follows accordingly that the so-called 'probable errors' of these constants are of relatively small significance in exactness, especially in the case of *small* samples, where their values are usually given by physicists and astronomers, as measures of accuracy of observation.

Lord **Rayleigh**: Further spectroscopic studies on the luminous vapour distilled from metallic arcs.—The appearance of high series members in the luminous vapour is due to their narrowness. In the arc these lines are so broad as to overlap; as the vapour emerges and expands, they become narrow and can be resolved. Enhanced lines occur in the distilled vapour, though in diminished intensity relative to the arc lines. In some cases, *e.g.* magnesium, they fade out very rapidly compared with the arc lines. The resonance line of mercury $1_1S' - 1p_2$ gains intensity relative to all other lines as the vapour matures. The same is true of calcium; but the corresponding line of magnesium behaves in the opposite manner. A luminous jet of one metallic vapour is able in many cases to excite the vapour of another metal injected into it, but generally only if the ionisation potential of the first metal exceeds the excitation potential of the spectrum line in question.

Sir William **Hardy**: A microscopic study of the freezing of gel (Part i. and Part ii.).

Sir William **Hardy** and Millicent **Nottage**: Studies in adhesion (i.).

T. **Moran**: The freezing of gelatin gels.

W. **Jevons**: The more refrangible band system of cyanogen as developed in active nitrogen.—Modification of the $\lambda 3590$ $(n'' - n' = -1)$ group and of some of the 'tail' bands is discussed. As regards the $\lambda 4216$ and $\lambda 3883$ groups, the afterglow develops especially lines of low m values and bands of high n' values. As n' increases the intensities of the bands in each group tend to show an alternation as well as a general increase. Bands with $n' = 1$ are the weakest. The $\lambda 3590$ group (like the above) is shortened in the low wave-length direction, but (unlike the above) it is prolonged in the high wave-length direction in the afterglow as compared with the arc, and also consists of headless bands. On the

assumption that these bands have $n''-n'=-1$, the absence of heads follows from the non-development of high m lines, and the high wave-length extension is in accordance with the enhancement of high-n' bands.

J. A. V. **Butler**: The equilibrium of heterogeneous systems including electrolytes (Part i.).

(The late) Mrs. Hertha **Ayrton**: Primary and secondary vortices in oscillating fluids: their connexion with skin friction.—Mrs. Ayrton demonstrated the existence of pressure differences on the lee side of obstacles in oscillating water and showed that vortices were formed in the liquid. These vortices were called 'primary' vortices when their full strengths were attained in one oscillation, and 'residual' vortices when more than one oscillation was required for their full development. The word 'secondary' is now substituted for 'residual.' Instantaneous photographs show that primary vortices occur near the ends of a tank in which water is oscillating and also near the nodes of stationary waves in such a tank, whilst secondary vortices spread throughout the remainder of the water.

T. T. H. **Verschoyle**: Isotherms of hydrogen, of nitrogen and of hydrogen-nitrogen mixtures at 0° and 20° C. up to a pressure of 200 atmospheres.—Experimental determination of isotherms of binary mixtures has been limited almost exclusively to mixtures of oxygen and nitrogen. It appears to be tacitly assumed that, for mixtures of the permanent gases, pv-values at normal temperatures are linear functions of composition. Isotherms of three mixtures of hydrogen and nitrogen have been measured at 0° and 20° C., and the results prove that the pv-values for the mixtures are far from being linear functions of the composition. Actually, a small admixture of nitrogen with hydrogen has relatively little influence on the pv-values, whereas a small addition of hydrogen to nitrogen has a comparatively great effect.

E. W. **Marchant** and J. L. **Miller**: The loss of energy in metal plates of finite thickness, due to eddy currents produced by alternating magnetic fields.—The energy lost due to eddy currents, produced by an alternating magnetic field, due to a flat circular coil, when placed near metal plates of different thicknesses, reaches a maximum for a certain thickness of plate. With a frequency of 50 cycles the loss is a maximum with copper plates about 0·4 cm. thick. A similar effect has been observed with zinc plates, though the maximum is not so definite. The mathematical theory worked out by Prof. Proudman is consistent with these results. The shape of the curve of the magnetic field is assumed to approximate to a Bessel function of zero order; a new integral is given for determining magnetic fields due to a coil of wire in terms of Bessel functions.

W. **Sucksmith** and H. H. **Potter**: On the specific heat of ferro-magnetic substances.

L. B. **Pfeil**: The effect of occluded hydrogen on the tensile strength of iron.—Tensile tests during electrolytic pickling of carbon-free iron are discussed. With iron in the ordinary finely crystalline condition, occluded hydrogen may result in a 10 per cent. reduction in tensile strength and an 80 per cent. reduction in elongation: the fracture, instead of passing *through* the crystals, as is normally the case, may pass only *between* the crystals. With single crystals, occluded hydrogen does not appreciably affect movement on the slip planes, but it materially decreases the cohesion across the cubic cleavage planes, the cohesion in certain cases being reduced to 5 tons per square inch. When the parallel portion of a test piece is made up of two large crystals, the weakest point is, in general, the intercrystalline boundary; the strength here is only about half that of the boundary between small crystals. The difference is due to the irregular path of the intercrystalline fracture in finely crystalline iron.

T. E. **Allibone**: The infra-red secondary spectrum of hydrogen.

D. C. **Rose**: The scattering of alpha particles through small angles.—The single scattering of alpha particles through angles from 1°·2 to more than 8° has been measured. A nearly parallel beam of alpha particles was projected perpendicularly on a thin gold foil and the number of particles emergent at the different angles was counted. The relative number of particles scattered at the different angles show that the nuclear field obeys the inverse-square law of force fairly closely, for distances between $0·4 \times 10^{-10}$ cm. and $1·7 \times 10^{-10}$ cm. from the nucleus. This region includes the K shell of electrons (radius, $0·69 \times 10^{-10}$ cm. for gold) calculated from Bohr's model of the atom. Other experimenters have shown that the nuclear field obeys the inverse-square law of force for distances between $0·5 \times 10^{-10}$ cm. and $3·2 \times 10^{-12}$ cm. from the nucleus. The absolute number of particles scattered show that over the same range the field corresponds to a nuclear charge within 5 per cent. of the atomic number times the elementary electronic charge. The results are not accurate enough to detect the shielding effect due to the K shell of electrons. The curves indicate that the K shell is not ionised to any appreciable extent. Wentzel's criterion for single scattering has been extended.

V. H. **Stott**, D. **Turner** and H. A. **Sloman**: Effects of thermal treatment on glass as shown by precise viscometry.—A new viscometer for molten glass has been designed; prolonged measurements can be made on the same specimen subjected to various heat treatments. The determination depends on the thickness of glass which adheres to a thin iridio-platinum wire withdrawn from the glass at a known velocity. The apparatus is capable of a precision of the order of $\pm$ 3 per cent. of the viscosity, which is equivalent to a temperature error of about 3°. At sufficiently high temperatures the viscosity of a particular glass is a function of temperature only. Below 1200° the glass is generally in a heterogeneous form yielding discordant viscosity values; the heterogeneity is not directly connected with devitrification, which takes place at approximately 950°. The glass, in its high-temperature state, may be cooled to room temperatures and reheated an indefinite number of times without change of state if the cooling and heating be not too slow.

J. E. **Lennard-Jones** and Miss B. M. **Dent**: The forces between atoms and ions (ii.).—Earlier results are extended to provide a complete table of forces between the monovalent and divalent ions of the inert gas type.

J. **Topping** and A. E. **Ludlam**: Tables of log $K_0(x)$ over the range $x=2$ to $x=12$ at intervals of 0·001.

B. **Lambert** and K. T. **Hartley**: An investigation of the effects of variations in the radiation factor on the efficiency of Dewar vessels.—The rates of evaporation of liquid oxygen and cooling of hot water have been determined in special Dewar vessels, with one or both of their vacuum-adjacent surfaces silvered, and with polished deposits of silver, gold, platinum, and copper on the vacuum-adjacent surface of the inner vessel, the outer vessel being plain glass. The result obtained by silvering the inner vessel only is almost as good as that obtained by silvering both surfaces. Silvering on the outer vessel only reduces

the efficiency by about a half. With different metal surfaces on their inner vessels, the order of efficiencies of the vessels should be that of the emissivities of these metals. This is the case for all the vessels with respect to hot water—the order being, silver, gold, copper, and platinum—but for liquid oxygen the copper-coated vessel is the least efficient. The dominant wave-length at the temperature of liquid oxygen approaches that corresponding to the 'characteristic frequency' of copper. For energy in this region of wave-lengths the emissivity of copper will therefore be high, so that copper vessels will necessarily be inefficient as containers for liquid oxygen.

J. E. **Lennard-Jones** and W. R. **Cook**: The molecular fields of hydrogen, nitrogen and neon.

H. **Florey**: Observations on the resolution of stasis in the finer blood-vessels.

T. S. P. **Strangeways** and Honor B. **Fell**: Experimental studies on the differentiation of embryonic tissues growing *in vivo* and *in vitro* (ii.). The development of the isolated early embryonic eye of the fowl when cultivated *in vitro*.

Nesta **Ferguson**: The Aloinæ—a cytological study, with especial reference to the form and size of the chromosomes.

Optical Society, June 10.—L. C. **Martin**: The distribution of light in elementary optical images. A series of calculations have been made on the distribution of light near the 'star focus' of a centred lens system in the following cases: (*a*) Freedom from aberration, (*b*) primary spherical aberration, (*c*) zonal spherical aberration. In the two latter cases the condition chosen is that when the least residual phase differences amount to $\pi/2$. The characteristic extra-focal effects are determined, and the effect of primary spherical aberration is discussed. In the case of zonal aberration the greatest axial intensity is not found at the focus giving least phase residuals. In both cases of aberration a concentration closely resembling in some respects the 'Airy' disc characteristic of zero aberration is found.—T. **Smith**: (1) The stationary value of axially symmetric functions. The formula for the stationary value of a function is put into a form which shortens the calculations involved in applying it to functions which possess special kinds of symmetry, such as that corresponding to symmetry about an axis. (2) Note on the criterion for the best position of focus. The position in which the amount of energy within the first dark ring of the diffraction image of a point is a maximum is suggested as not unlikely to correspond with the best focus found by visual observation in the presence of moderate amounts of aberration.

PARIS.

Academy of Sciences, May 25.—L. **Lecornu**: The rotating millstone.—P. A. **Dangeard**: Researches on the cellular formations contained in the cytoplasm of the Peronosporæ.—Alfred **Rosenblatt**: Algebraical varieties of three dimensions of which the types satisfy the inequality $P_g \leqq 3\,(p_g - p_a - 3)$. — Pierre **Humbert**: The q-harmonic functions in hyperspace.—R. **Gosse**: On a note of M. Lainé.—**Goursat**: Remarks on the preceding communication.—Georges **Valiron**: Meromorph functions without asymptotic values.—A. **Toussaint** and E. **Carafoli**: Contribution to the study of the plane flow of fluids. A new mode of applying the coloured thread method possessing certain advantages over that previously used (Marey, Hele-Shaw). The paths can be followed by the kinematograph.—Albert **Nodon**: A colloid condenser. This condenser is composed of two sheets of aluminium separated from each other by a material such as canvas, the pores of which are filled up with a thick paste of colloidal ferric oxide and glycerol. This arrangement fulfils the functions of an electrostatic condenser of great capacity, when submitted to an alternating current.—R. **Forrer**: The structure of the atomic magnet. Demonstration of the existence of a doublet in nickel.—H. **Mineur**: The theory of the partial entanglement of the ether.—W. **Kopaczewski** and W. **Szukiewicz**: The periodicity of colloidal reactions.—Jean **Barbaudy**: The miscibility, densities, and refractive indices of mixtures of methyl alcohol, benzene, and water.—P. **Chevenard**: The dilatometric anomaly of the paramagnetic nickel-chromium alloys; an alloy suitable for an expansion pyrometer. The nickel-chromium alloy suggested in an earlier communication as suitable for use in a pyrometer shows an anomaly at the temperature of 550° C. To remove this anomaly it is sufficient to increase the amount of manganese, to incorporate a small percentage of iron, and to replace a part of the chromium by tungsten. The new alloy (commercial name Pyros), besides nickel, contains 7 per cent. chromium, 5 per cent. tungsten, 3 per cent. manganese, 3 per cent. iron.—Raymond **Quelet**: The synthesis of derivatives of para-bromoallylbenzene.—A. **Kastler**: Contribution to the study of pollucite. The pollucite examined proved to be non-radioactive and contained 30·5 per cent. of cæsium.— —**Legrand**: A relation between the amplitudes of the annual rise of the Nile, the Niger and the Mekong.—J. **Lacoste**: Earthquakes observed in central France in 1925. Seven earthquakes were noted, the more important being on September 26, December 3 and 9. Details are given of the three mentioned.—Armand **Renier**: The existence of coal balls in the coal basin of Asturia.—J. **Giaja** and X. **Chahovitch**: The inefficacity of pilocarpine to affect the energy metabolism in the absence of the suprarenal capsules.—A. Vedel **Tåning**, The position of the cephalic disc in the Echeneideæ in the course of ontogenesis.—Ph. **Joyet-Lavergne**: The vital colorations of the gregarines and the characters of sexualisation of the cytoplasm.—Y. **Manouélian** and J. **Viala**: The enhancement of the virus of rabies and the Negri bodies.

ROME.

Royal National Academy of the Lincei, April 18.—Leonida **Tonelli**: Quadrature of surfaces.—A. **Angeli**: Anomalies of certain reactions. A number of cases are quoted in which a reaction of one substituent group in an organic compound may be retarded or even prevented by the introduction into the compound of another substituent.—Federico **Sacco**: The tunnel at Drink (Valle d'Aosta).—Achille **Russo**: The ex-conjugants derived from the first accessory conjugation between impure gametes in *Cryptochilum Echini* produce pure gametogens and pure gametes, which renew the principal cycle.—Alessandro **Weinstein**: The speed of propagation of the solitary wave.—Giorgio **Vranceanu**: Dirichlet's theorem.—Arnaldo **Masotti**: An extension of Blasius's formula.—Eligio **Perucca**: The cause of 'flying shadows.' If the phenomenon of flying shadows is one of diffraction, it must be more complicated and more indirect than is indicated by Armellini's theory. The absence of chromatism and the velocity with which these shadows are propagated suggest that the cause should be sought in the earth's atmosphere.—Enrico **Fermi**: The intensity of prohibited lines in intense magnetic fields.—Franco **Rasetti**: The polarisation of the light emitted by electronic shock.—Giorgio **Piccardi**: Ionisation potential of silver. By means of the flame method of Rolla and Piccardi, values ranging from 7·37 to

7·67 volts are obtained for the ionisation potential of silver, the mean being 7·46 volts. In view of the inaccuracy introduced by the impossibility of avoiding slight sparkling of the fused metal, this result agrees satisfactorily with the value, 7·54 volts, derived from the limits of the spectral series.—Carmela **Ruiz**: New investigations on barytes from Racalmuto, Sicily. Measurements of two specimens of barytes, occurring together with calcite and sulphur at Racalmuto, gave the axial ratios, $a:b:c = 0{\cdot}81558:1:1{\cdot}31467$, and the density 4·42-4·43 at 18°-19°.—Gustavo **Cumin**: Geological observations on the island of Asinello and on neighbouring rocks (Carnaro). The island of Asinello and the neighbouring rocks are mostly Cretaceous, Eocene measures appearing only on the principal island. Their coast morphology is the result of an aerial erosive action, on to which the marine action has been superposed.—F. Stella **Starrabba**: Monthly distribution of the eruptions of Japanese volcanoes.—Giulio **Cotronei**: Dark and light fibres in the insular organ of *Petromyzon marinus*.—B. **Monterosso**: The structure of the body of *Peroderma cylindricum* Heller, in relation to the cellular theory.

VIENNA.

Academy of Sciences, May 14.—V. **Oberguggenberger**: Determination of altitude of the pole at the Innsbruck Observatory with the help of Oppolzer's zenith telescope.—V. **Pietschmann**: A new deep-sea fish of the order Pediculati.—E. **Keller**: Curved perspectives.—M. **Kohn** and A. **Zandmann**: Communication on bromo-phenols, xxi. Display of new halogen-phenols from *m*-chloro-phenol.

Official Publications Received.

Department of the Interior: U.S. Geological Survey. Bulletin 781B: Geology of the Baxter Basin Gas Field, Sweetwater County, Wyoming. By Julian D. Sears. (Contributions to Economic Geology, 1925, Part 2.) Pp. ii+13-29+plates 2-6. Water-Supply Paper 542: Surface Water Supply of the United States, 1922. Part 2: South Atlantic Slope and Eastern Gulf of Mexico Basins. Pp. iv+74+2 plates. 10 cents. Water-Supply Paper 546: Surface Water Supply of the United States, 1922. Part 6: Missouri River Basin. Pp. vii+349+2 plates. 35 cents. Water-Supply Paper 552: Surface Water Supply of the United States, 1922. Part 12: North Pacific Slope Drainage Basins. A: Pacific Basins in Washington and Upper Columbia River Basin. Pp. v+203+2 plates. 25 cents. Professional Paper 138: Mining in Colorado; a History of Discovery, Development and Production. By Charles W. Henderson. Pp. iv+263+1 plate. 1 dollar. Professional Paper 140A: Geology of the Latah Formation in relation to the Lavas of the Columbia Plateau near Spokane, Washington, by J. T. Pardee and Kirk Bryan; Flora of the Latah Formation of Spokane, Washington, and Coeur d'Alene, Idaho, by F. H. Knowlton. (Shorter Contributions to General Geology, 1925.) Pp. iv+81+31 plates. Professional Paper 140B: Fossil Proboscidea and Edentata of the San Pedro Valley, Arizona. By James Williams Gidley. (Shorter Contributions to General Geology, 1925.) Pp. ii+83-95+plates 32-44. Professional Paper 140C: Pleistocene Plants from North Carolina. By Edward Wilber Berry. (Shorter Contributions to General Geology, 1925.) Pp. ii+97-119+plates 45-57. Professional Paper 140D: Shore Phases of the Green River formation in Northern Sweetwater County, Wyoming. By Wilmot H. Bradley. (Shorter Contributions to General Geology, 1925.) Pp. ii+121-131+plates 58-62. (Washington, D.C.: Government Printing Office.)

Proceedings of the Academy of Natural Sciences of Philadelphia. Vol. 77, 1925. Pp. iii+388+11 plates. (Philadelphia, Pa.)

Fortieth Annual Report of the Bureau of American Ethnology to the Secretary of the Smithsonian Institution, 1918–1919; with accompanying Papers—The Mythical Origin of the White Buffalo Dance of the Fox Indians, by Truman Michelson; The Autobiography of a Fox Indian Woman, by Truman Michelson; Notes on Fox Mortuary Customs and Beliefs, by Truman Michelson; Notes on the Fox Society known as 'Those who Worship the Little Spotted Buffalo,' by Truman Michelson; The Traditional Origin of the Fox Society known as 'The Singing Around Rite,' by Truman Michelson. Pp. viii+664. (Washington, D.C.: Government Printing Office.) 2·75 dollars.

Journal of the Manchester Egyptian and Oriental Society. No. 12. Pp. 59. (Manchester: University Press; London: Longmans, Green and Co., Ltd.) 7*s.* 6*d.* net.

Proceedings of the Imperial Academy. Vol. 2, No. 3, March. Pp. v-vi+93-147. (Ueno Park, Tokyo.)

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 15: The Resistance of the Airship Models measured in the Wind Tunnels of Japan. By the Wind Tunnel Committee specially appointed by the Aeronautical Council of Japan. Pp. 84. (Tôkyô: Maruzen Kabushiki-Kaisha.) 2 yen.

Annual Report of the Zoological Societ... 31st March 1926. Pp. 59+6 plates. (Edinburgh.)

Observatoire de Zi-ka-wei. Notes de sismologie, No. 7: Mouvements sismiques des magnétomètres à Zi-ka-wei et à Lu-kia-pang (1877–1924). Principaux sismogrammes, 1925. Par le Rev. P. E. Gherzi. Pp. 33+7 planches. (Zi-ka-wei, Chang-hai.)

Proceedings of the Royal Society of Edinburgh, Session 1925–1926. Vol. 46, Part 2, No. 19: The Wheatstone Bridge as the Means of Measuring Linear and Angular Dimensions at a Distance, and its Application to Borehole Surveying. By Prof. Henry Briggs. Pp. 223-229. 1*s.* Vol. 46, Part 2, No. 20: On Fertility in the Domestic Fowl. By Dr. F. A. E. Crew. Pp. 230-238. 9*d.* (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Empire Cotton Growing Corporation. Report of the Administrative Council of the Corporation to be submitted at the Fourth Annual General Meeting on June 9th, 1926. Pp. 32. (London: Millbank House, Millbank, S.W.1.)

Spisy vydávané Přírodovědeckou Fakultou Masarykovy University (Publications de la Faculté des Sciences de l'Université Masaryk). Čis. 64: Oblastní odtoková mapa Moravy (Carte géographique du débit d'eau relatif de la Moravie). Napsal Dr. Fr. Koláček. Pp. 13+1 tab. Čis. 65: "Tanytarsus connectens." Par Dr. Jan Zavřel. Pp. 47+1 tab. Čis. 66: Morfologický vývoj Hlučínska (The Morphological Development of Hlučín). Napsal Dr. Fr. Vitásek. Pp. 38+1 tab. Čis. 67: Terasy dolní Svitavy a dolní Svratky (Les terrasses de la Svitava inférieure et de la Svratka inférieure.) Napsal Fr. Říkovský. Pp. 17+8 tab. Čis. 68: O absorpci chlorovodíku a kysličníku siřičitého v kyselině sírové a v kyselině octové [Pokračování] (On the Absorption of Hydrogen Chloride and Sulphur Dioxide in Sulphuric Acid and Acetic Acid [Continuation].) Napsal Václav Čupr. Čis. 69: O *W*-kongruencích s fokálními plochami přímkovými (Sur les congruences *W* dont les surfaces focales sont réglées). Napsal J. Klapka. Pp. 31. (Brno: A. Píša.)

Sborník Vysoké Školy Zemědělské v Brně (Bulletin de l'École supérieure d'Agronomie, Brno). Sign. C1: Oxydimetrické studie o antimonu (Oxydimetric Studies on Antimony). Napsal Prof. Dr. J. Knop. Pp. 22. Sign. C2: O gravimetrickém poměru mezi antimonem a antimontetroxydem (Observations on Gravimetric Proportion between Antimony and Antimony-Tetroxide). Napsal Prof. Dr. J. Knop. Pp. 10. Sign. C3: Implantace volných fragmentů kostních pomocí omenta u psů (Implantation des fragments osseux libres à l'aide de l'omentum chez les chiens). Napsal Prof. Dr. Theodor Dobnal. Pp. 18+5 tab. Sign. C4: Studie o změnách, zvláště analytických konstant tuku máselného, vlivem paprsků ultrafialových (A Study of the Changes, particularly of Analytical Constants of Butter Fat, under the Influence of Ultraviolet Rays). Napsal Dr. Josef Špinka. Pp. 38. Sign. C5: Příspěvek k poznání nutritivního významu látek ve vodě rozpustěných pro vodní zvířata (A Contribution to the Knowledge of the Nutritive Importance of the Substances dissolved in Water for Water-Animals). Napsal Dr. Jan Podhradský. Pp. 53+3 tab. Sign. C6: Stupňování vzrůstu zvířat vitaminovými preparáty z obilních klíčků (Stimulation de la croissance des animaux par les préparations des vitamines des germes du blé). Napsal Dr. Jaroslav Kříženecký a Dr. Jan. Podhradský. Pp. 60+16 tab. Sign. D1: Rok hladu u Abies Nordmanniana Lk. 1 Část: Varianty jehlic (A Year of Hunger at Abies Nordmanniana Lk. 1 Part: The Variants of Spines). Napsal Prof. Dr. Otakar Vodražka. Pp. 13+1 tab. Sign. D2: Synthesa škrobu u různých rostlin za přítomnosti solí vápníku a sodíku: Fysiologicko-oekologické výzkumy (The Synthesis of Starch in different Plants under Presence of Salts of Calcium and Sodium: Physiologic-oecological Researches). Napsal Prof. Vasil Sergějevič Iljin. Pp. 27. Sign. D3: Nové rody Lycoriid (s bezkřídlými samičkami) z lesní půdy (Genres nouveaux des Lycoriides (avec des femelles aptères) du sol de forêts). Napsal Antonín Vimmer. Pp. 16+1 tab. (Brně: A. Píša.)

Diary of Societies.

MONDAY, JULY 5.

ROYAL INSTITUTION, at [illegible].—General Meeting

CONFERENCES.

MONDAY, JULY 5.

ROYAL SANITARY INSTITUTE (at Guildhall), at 3.—Right Hon. Neville Chamberlain: Inaugural Address.

TUESDAY, JULY 6.

ROYAL SANITARY INSTITUTE (at Mansion House, Central Hall, and Institution of Civil Engineers), at 10.—Sections A (Sanitary Science and Preventive Medicine), C (School Hygiene). Discussions: Sanitary Authorities; Engineers and Surveyors; Sanitary Inspectors.

WEDNESDAY, JULY 7.

ROYAL SANITARY INSTITUTE (at Caxton Hall, Central Hall, and Guildhall), at 10.—Sections A (Sanitary Science and Preventive Medicine), E (Hygiene of Food), F (Hygiene in Industry). Joint Session with Maternity and Child Welfare Conference. At the Royal Sanitary Institute, at 3.—Prof. C. E. A. Winslow: Appraisement of Health Administration.

THURSDAY, JULY 8.

ROYAL SANITARY INSTITUTE (at Central Hall and Institution of Civil Engineers), at 10.—Sections B (Engineering and Architecture), D (Personal and Domestic Hygiene). Discussions: Port Sanitary Authorities; Veterinary Inspectors.

FRIDAY, JULY 9.

ROYAL SANITARY INSTITUTE (at Central Hall and the Institution of Civil Engineers), at 10.—Section B (Engineering and Architecture). Discussions: Medical Officers of Health; Veterinary Inspectors; Health Visitors.

NATURE

SATURDAY, JULY 10, 1926.

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Reconstitution of the University of London.

THE Government has redeemed its pledge to introduce legislation "to make further provision for the University of London." The University of London Bill, which, on the motion of the Earl of Balfour, was accorded its second reading in the House of Lords on June 29, proposes to appoint eight commissioners with plenary powers to draft statutes for the University "in general accordance" with the recommendations contained in the Report of the Departmental Committee of the Board of Education appointed by Mr. Trevelyan in 1924, subject to any modifications which may appear to them to be expedient. Thus the procedure is assimilated to that adopted in the recent reconstitution of the Universities of Oxford and Cambridge. There are, however, important differences between the two cases. Whereas the reconstitution of the ancient universities was based on the recommendations of a Royal Commission of great authority, presided over by Mr. Asquith (now Lord Oxford)—recommendations which were unanimous save for some relatively unimportant reservations by individual members—the proposed reconstitution of the University of London is to be based, not on the recommendations of the Royal Commission, generally known as the Haldane Commission, which reported in 1913, but on the recommendations of a Departmental Committee of the Board of Education. Conditions, it is true, have changed since the Haldane Commission reported. The reception accorded to the Departmental Committee's report has been comparatively friendly, but it cannot be overlooked that the constitution proposed by the Committee differs essentially from that suggested by the Royal Commission.

Another difference relates to the historical development of the universities in question. Broadly speaking, Oxford and Cambridge have retained their traditional constitutions, based on the University of Paris. They remain corporations governed by their graduate members. Certain internal reforms, such as the abolition of the celibacy of college fellows, have been effected by the pressure of public opinion. But external control in any form has always been resisted, notwithstanding acceptance of generous financial aid from the Government. The presence of outside representatives on the Council, the Royal Commission reported in 1922, "would hamper the Council in its work without securing as a rule any compensating advantage"; and the objection to representatives nominated by the Government appeared to the Commission "particularly strong."

The University of London was established by Royal Charter in 1836 with a Senate nominated by the Government to administer its educational affairs, the Government retaining full financial control. It was not until

1858 that the graduates secured a share in the administration of the University, when the privilege of nominating for a limited number of seats on the Senate was conceded to Convocation under a new charter. Forty years later the teachers of the colleges and medical schools in London were accorded a similar privilege, the Act of 1898 reconstituting the University as a teaching university. The reconstitution now under discussion in Parliament derives its motive force from the demand of the Government, voiced by the University Grants Committee, for an improved financial and executive control.

The schedule of the University of London Act of 1898 gave to the Commissioners named in the Act detailed directions for the constitution of the Senate. It enforced the 'advisory' character of its chief councils, provided safeguards for religious and sex equality, prescribed the radius for the recognition by the University of public educational constitutions, insisted that the internal and external degrees of the University should represent "as far as possible the same standard of knowledge and attainment," and gave instructions on several other matters. These provisions were fully discussed by Parliament. If the present Bill passes, Parliament will abrogate its right to discuss the details of academic organisation, reserving only the right to reject statutes. Government of a university by statutes without rigid and permanent directions from Parliament offers certain obvious advantages, provided fundamentals are safeguarded. Statutes can be amended to meet changing conditions without cumbersome Parliamentary procedure. Under the present Bill, statutes for the University can be altered or supplemented by the University, except statutes, if any, that the Commissioners may consider ought not to be altered by the University. The Bill directs the Commissioners, before adopting statutes, to receive representations "by or on behalf of the Senate or Convocation or any fifty graduates of the University, or by or on behalf of any other bodies or persons appearing to the Commissioners to be directly affected by the proposed statute"; and there are the usual provisions for the approval of statutes by the Privy Council. Thus the arrangements for publicity and for preliminary discussion by those specially qualified are adequate.

This is not the occasion for a detailed discussion of the recommendations of the Departmental Committee, either at large or in relation to the promotion of scientific education and research. Controversy has so far centred—as was to be expected—round the status and powers of the proposed Council which is to be given financial and executive control. This reform is fundamental; but the question of the relation of the Council to the Senate, the body responsible for educational policy, will have to be closely examined by the Commissioners. Presumably all the proposed Commissioners are already in agreement as to the creation of the Council. On other matters, the Commissioners can adopt modifications of the Departmental Committee's recommendations, and no doubt many suggestions will be forthcoming in due course in regard to such matters as the number and mode of election of heads of colleges as members of the Senate, the devising of some method more dignified than co-option of appointing a number of members of the Senate as independent experts or on grounds of services rendered to the University—the elder statesmen or aldermen of the University—and the appointment of the Principal as a member of Senate and Council *ex officio*. Statutes should also authorise the payment of fees to members of the Council, thus emphasising the serious nature of their duties and the demands on their time and energy.

The important question of the relation of the University to its affiliated colleges is a matter which will be within the competence of the Commissioners, who may make statutes for the colleges, subject to the consent of the respective governing bodies. Their powers appear to extend to the incorporation or disincorporation of colleges in the University, a subject of acute controversy within the University. Under the present statutes, colleges were affiliated to the University without any clearly defined privileges and obligations, and it will be of great advantage both to the University and to its colleges if their relations are placed on a firmer basis.

The personnel of the Commissioners has been selected with care and judgment. The chairman, Mr. Justice Tomlin, will ensure judicial treatment of the questions to be considered. Two graduates of the University, Sir Josiah Stamp and Prof. T. P. Nunn, and the present Principal Officer, Sir Cooper Perry, who will retire from his University office shortly, may be deemed to represent the University. The point of view of the Board of Education and the London County Council will be represented by Sir Amherst Selby-Bigge, the late Secretary of the Board, and Sir Cyril Cobb respectively. Oxford contributes a representative in the Master of Balliol (Dr. A. D. Lindsay), and the special interests of women will find a natural protector in Miss Philpotts.

Past history has shown that the University of London through its graduates can exercise powerful political influence. Will that influence be used on the present occasion against the Bill? Convocation, at a sparsely attended meeting held during the strike, adopted three resolutions declaring that the creation of a Council to control the finances of the University would have

"prejudicial effects upon the University"; that the reconstitution of the Senate in accordance the mmendation of the Departmental Commission would be "a grave error"; and, finally, strongly deprecated the setting up of a Statutory Commission. The Senate has adopted a resolution declaring its opinion that as regards the relative positions of the Council and the Senate, the scheme proposed by the fajority Report of the Departmental Committee should rejected on the ground that it will be found to be workable in practice, that it will deprive the truly resentative body (the Senate) of all effective control, t it will not clear the body charged with control of ance from any possible imputation of partiality; and lly, that it will complicate further the already too plicated machinery of the University. The Senate her offered to submit a scheme of agreed reforms. inference to be drawn from this resolution is that Senate would prefer that the Council, if created, ld have the status of a statutory finance committee. ne final suggestion. Would it not be well for the ernment to make some announcement as regards eased financial aid for the work of the University, nd when reconstituted? The great developments in iversity education, which London, as the capital of Empire, urgently needs, cannot be accomplished, vever perfect a constitution may be provided by authority of the Government, unless the money is thcoming. The University may reasonably expect Government, which has shown so much solicitude its spiritual welfare, to contribute generously to its terial needs.

T. LL. HUMBERSTONE.

Eugenic Reform.

Need for Eugenic Reform. By Leonard Darwin. Pp. xvii + 529. (London: John Murray, 1926.) 12*s.* net.

HIS is in every respect a notable book by a most distinguished author. Major Darwin has now or fifteen years occupied the presidential chair in the Eugenics Education Society, and comparatively few ealise the services which he has rendered towards naking clear the social implications of the results of he scientific study of heredity. The word 'Eugenics' ignifying 'the study of the agencies under human ontrol by which the human stock can be improved' vas coined by Galton, as most people know. Most are lso aware that it was associated in the public mind vith a number of fantastic projects for the compulsory nating of specially selected specimens of opposite exes in order to improve the race. For this concepion of the subject Galton is directly responsible; it has ed to eugenists being regarded as a collection of faddists, and has drawn on to the whole subject the sharpest shafts of ridicule and sarcasm. G. K. Chesterton has said of eugenic reform that it could be imposed only on slaves and cowards, and it is, no doubt, of 'Galtonian' reforms that he was thinking when he made this statement.

The present reviewer is forced to confess that he formerly shared the common attitude towards the subject, an attitude which, as he must regretfully admit, is still maintained by some of his most admired scientific friends. It was in 1913, when he had the good fortune to listen for the first time to a presidential address by Major Darwin, that the reviewer first saw that a wholly different interpretation could be given to eugenic reform, an interpretation calculated to appeal strongly to the common sense of all who take the trouble to give their attention to the subject. This interpretation, which, though theoretically admitted, was not regarded as of practical importance in comfortable Edwardian days, is now forcing itself on the attention of every one who has to deal with social affairs. Major Darwin pointed out that, if we went on fostering the unrestricted multiplication of the least competent members of the nation by continually increasing doles extracted from the pockets of the more competent and therefore well-to-do, we should inevitably lower the quality of the race. It is a sinister portent that the large families which were reared in our rectories and in the manses of Scotland in Victorian days, from which we gathered so many distinguished and able men, have disappeared, whilst there is no serious diminution in the offspring of our dock labourers and unskilled workers. Major Darwin's conception of eugenics was essentially the extension of his father's doctrine of natural selection to human affairs.

The book which we are considering opens with a biological introduction which deals with the Mendelian theory of heredity and discusses the inheritance of acquired qualities and the Lamarckian theory of evolution. This part is by far the weakest section of the book, for Major Darwin labours under the disadvantage of not being a biologist, and this disadvantage is increased by the fact that, as he admits in the preface, he has relied for assistance and advice mainly on Mr. R. A. Fisher and Mr. C. B. S. Hodson. Of these the first is a mathematician, and the second name is obviously a slip for Mrs. Hodson, the respected assistant secretary of the Eugenics Education Society, who undoubtedly has had some training in biology, but is scarcely fitted to give serious criticism in this subject.

Major Darwin accepts the extreme Mendelian view, namely, that the whole force of heredity in any individual is capable of being analysed into a series of units or 'genes,' and that a chance assortment of 'genes' is

handed on by the parent to his children. This view, which has been rejected by many biologists with a really wide outlook on the science, including systematists, embryologists, and palæontologists, leads, if logically pressed, to impossible and absurd conclusions. The innate common sense of Major Darwin leads him to see this: he plaintively confesses that if genes are unalterable he cannot see how evolution can ever have taken place, for all the genes which make up human heredity must have been present in the original amœba. It may be added that the 'factorial analysis' of heredity adds nothing to our knowledge of the subject: the 'genes' or 'factors' are purely imaginary units, and the number is continually added to as Nature shows herself unwilling to be compressed within mathematical formulæ. As the author naïvely confesses, it is impossible to devise means of analysing human capacities into genes, and eugenic reform cannot wait whilst the attempt is made; therefore Mendelism is of service to eugenics chiefly by fostering belief that heredity is not a haphazard thing but follows fixed rules. But this belief is far older than Mendelism; no farmer, nor even any common-sense observer of human affairs, needed Mendel to teach him this; it is expressed in unequivocal language by the Founder of Christianity himself: "neither can a corrupt tree bring forth good fruit."

Major Darwin is no happier in his criticisms of Lamarckism. He points out that there are certain qualities which he does not think could have been 'acquired' in this sense by animals; as, for example, the protective resemblance shown by the plumage of a bird. How, he asks, could the bird know when its plumage assimilated with its surroundings? Well, we do not know how a bird would react to changed surroundings, but we do know that many reptiles, amphibia, and fishes can and do control their colour so as to make it match their environment, and that this control is exercised through the eye. If Major Darwin will keep a common frog in a dark tank he will find that it soon assumes a very dark brown tint. If it is now removed to a white porcelain dish it will in half an hour assume a light straw-coloured tint. If, however, the optic nerves of the dark frog are severed, it will remain dark on the whitest porcelain. What goes on in the mind of the frog, what it feels or thinks, neither Major Darwin nor any one else knows.

Then Major Darwin says that whilst doubtless a muscle increases in size with use, Lamarckians have never explained how this power was 'acquired.' On this subject it is necessary to speak firmly and decisively. Neither Lamarck nor any other competent biologist has ever advanced a theory to explain how living beings could develop out of dead matter. The fundamental properties of life are as clearly manifested in amœba as in man; every faculty shown in the higher forms of life is present in the simplest form in germ—*ex nihilo nihil fit*. These properties are the presupposition of every valid theory of evolution. This was clearly seen and expressed by no less a person than Alfred Russel Wallace. The author's third objection that Lamarckian change, if it really occurs (and his father admitted that it did), is extremely slow in its action and can therefore be left out of account in considering eugenic measures, has a considerable measure of truth in it; yet even here a *caveat* must be entered. It is not the case that "millions of years" are needed to effect any noticeable change. It is not "millions of years" since palæanthropic man ranged over Europe, and yet since that time we have acquired straight backs and thighs. The Lamarckian view is that evolution is due to changes of habits (in Lamarck's phrase, the effort to satisfy new needs awakened by new surroundings), and that these habits induce changes in structure which are passed on to the next generation. The first stage in this transmission consists merely in a quickened response to the same stimulus which induced the corresponding change in the parent. It is only after a long time that the change becomes so engrained in the constitution that it appears without the stimulus at all. Baron Nopčsa, in a recent brilliant address to the London Zoological Society, pointed out that in the adaptations which fit the human leg to maintain the upright position both stages can be found. The thickened pad on the sole of the foot appears whilst the embryo is in the womb, but the change in the ankle-joint only appears after walking has begun, and fails utterly to appear if the foot for any reason is not used. It is quite probable that good education—the development of the brain by mental exercise, not the cramming of it with facts—does leave in the progeny of the educated an increased capacity to learn.

Besides Lamarckian adaptation, however, which being an epitome of the past history of the species, accounts for the racial differences which divide mankind, there is another kind of variation prominent amongst our domestic animals which also occurs largely amongst civilised city-dwellers, who, like the denizens of the farmyard, are domesticated. This is a weakening of developmental energy caused by bad conditions surrounding the germ in its earliest period of growth. This weakening produces a disharmony in growth which results in weird structural aberrations, and once produced it is handed on to subsequent generations and produces the same result in the progeny as in the parents. To this cause not only the 'fancy' character of our domestic breeds but such pathological aberrants as epileptics and mental defectives owe their origin. Nevertheless, if such individuals are transferred to

healthy natural surroundings *and left to support themselves by their own efforts,* this plasma-weakness gradually passes off and the natural structure is regained. A beautiful example of this reversion can be seen every day in London; and it is one which seems to have been going only for forty or fifty years, since it is never mentioned in the works of Charles Darwin, and it would have greatly interested him had he seen it. As all know, pigeons originally escaped from dove-cotes have multiplied all over London and maintain themselves in our squares, no doubt in the innocence of their hearts mistaking our tall London houses for their ancestral cliffs. A large proportion of these pigeons are assuming the plumage and shape of the wild rock pigeon, yet this is certainly not due to crossing, for the wild progenitor is now an exceedingly rare bird and is in fact almost extinct. So the emigration of a city-stunted population to Australia, if they were not coddled but left to their own efforts, might in time give rise to a population of respectable physique.

The author, as in filial duty bound, attaches great importance to natural selection--and so do we. If advance is the result of energy and vigorous striving, a race will progress only as the weak and lazy are eliminated or, at any rate, prevented from procreating progeny --and in this lies the central core of all Major Darwin's proposals. He points out the disastrous effects of public assistance; the class assisted does not increase in its efforts at self-maintenance, but depends more and more on doles; and it increases in fertility whilst the class from whom assistance is drawn diminishes in numbers. He then considers how the elimination of the less worthy class might be promoted. He considers, and rightly so, that parenthood should be prevented in the case of all certifiable as mentally defective. This ould be accomplished if lifelong segregation were nstituted with the acceptance of voluntary sterilisation and freedom as an alternative. He thinks that parenthood should be prohibited even in cases where the nental defect is held to be due to 'environmental factors,' since even if such parents would not hand on he defect to their children—and we consider it very probable that they would do so—they are quite unfit to give parental care and good upbringing. Major Darwin discusses the objections to sterilisation which are both futile and sentimental. It is objected that sterilised individuals would feel free to adopt an immoral life. This, we might rejoin, is not our business: they are in no way forced to do so, and even if they did, his would be a very much lesser evil than the contamination of the next generation by them. After all, people who now desire an immoral life are deterred not by the fear of illegitimate offspring, but the dread of venereal disease; yet that is no argument against stamping out that disease if we can. The author would further sterilise or segregate the habitual criminal, and when hard necessity has made us shed some of our sentimentalism we shall agree with him. As he remarks, 120,000 new recruits join the ranks of labour every year, and yet it seems probable that our trade will never rise to its pre-War level, so that some regulation of population is an absolute necessity.

This necessity, it seems to us, can only be met by birth-control; that is, limitation of size of family. Here, however, the author shows himself fussy: he is afraid that contraceptive measures in certain circumstances might do harm. The answer to this is that since contraceptive practices are widespread amongst the more intelligent members of the community, to extend the knowledge of them amongst the class that is multiplying too quickly can do no harm. Of course, as Major Darwin sees, this would leave the utterly reckless class uninfluenced. So the right of any one to have children whom he cannot support must be challenged sooner or later, and the ultimate remedy for that is the threat of sterilisation if the family is added to. It seems to us that another remedy not envisaged by the author would be to treat all public assistance as a loan which must be repaid before the beneficiary is allowed to vote.

Major Darwin then goes on to discuss mate-selection, divorce, and kindred matters. On the question of divorce he is stern and conservative. Like all eugenists, he considers marriage as an institution mainly for the purpose of the next generation and family life as indispensable, and this life would inevitably be destroyed by easy divorce. As to mate-selection, no doubt prudence should be exercised in selecting a wife, both with regard to health and character, but as the author truly remarks, love laughs at locksmiths, and once passion is aroused, prudence is apt to be thrown to the winds. Hence, where care ought to be exercised is in the quality of the opposite sex with which our children are familiarised during their young and formative years, for this quality will create the ideals which will arouse passion later on.

The conclusion of the volume is naïve and surprising. The author having come to the conclusion that 'science,' as he conceives it, leads to a mechanical conception of the universe and causes him to regard his fellow-being as an automaton, and as therefore having no individual rights as compared with the welfare of the race, yet finds, when he looks within, that he is a being with a free-will; and so he rejects the conclusions to which 'science' leads him. This he regards as an antinomy which he is powerless to resolve. It might perhaps have induced him to inquire whether the postulates of his 'science' were not doubtful; whether, in fact, we

of the order. The first main section of the book is devoted to ontogeny, or individual development, from fertilisation of the egg to the eclosion of the imago. With regard to oviposition certain remarkable facts are alluded to. It appears that *Polyommatus rutilis* consistently lays its eggs in pairs, one egg of the pair producing a male and the other a female. There appears, furthermore, to be an alternation of male- and female-producing eggs in the ovarioles. With regard to *Papilio memnon*, some of the eggs are laid in pairs and others singly; the eggs in pairs produce male insects, while the isolated eggs give rise to females. In discussing parthenogenesis, the Psychid moth *Solenobia triquetrella* F. is mentioned as reproducing by this method in northern Germany, while in the southern form of this species fertilisation is the invariable rule.

The second section is concerned with the life of the imago. A very full account is given of the significance and distribution of the various types of scent scales and tufts that are so frequent among Lepidoptera. Some reference is also made to the presumed chemical nature of the odours produced. Senses and tropisms are likewise discussed at length, and there is a useful summary of what is known concerning the tympanal organ, mainly through the work of Eggers.

The third section, which extends to more than 240 pages, will commend itself to the general biologist. Here the author elaborates his views on geographical distribution, dimorphism, coloration, mimicry, etc. Certain of the conclusions that are arrived at are not convincing, such as the following. Large-sized species are more generalised than small-sized; the spring generation of seasonally dimorphic forms is more primitive than the summer brood; the lengthier the feeding period of larvæ and the shorter the pupal instar is an indication of primitiveness. With reference to the significance of colour patterns the classification of Heikertinger is followed, and we note in the discussion on mimicry there appears to be no mention of the name of Poulton.

The long chapter on leaf- and other miners is particularly good, and the author adopts a convenient terminology indicative of the different kinds of mines produced. The relations of Lepidoptera to ants and termites likewise form the subject of a separate chapter, and in this connexion the absence of any reference to the remarkable Lycænid *Liphyra brassolis* is unexpected. Further on in the book coloration is dealt with, both from its environmental and experimental aspects, while hermaphroditism, intersexuality, hybridism, all come in for discussion, along with other subjects too numerous for separate mention.

The bibliography at the end of the volume is intentionally restricted but it is too short to be an adequate guide to the literature. We miss reference to a number of leading authorities through the book, while many authors are quoted with no indication other than the date as to where their work is published. In whatever features one may disagree, however, they are insufficient to obscure the outstanding merit of the book.

A. D. IMMS.

Our Bookshelf.

Practical Hints to Scientific Travellers. Edited by Prof. H. A. Brouwer. Vol. 1. Second, revised edition. Pp. v+122+9 plates. Vol. 2. Second, revised edition. Pp. v+150+7 plates. Vol. 3. Pp. v+185+6 plates. (The Hague: Martinus Nijhoff, 1925.) 5 guilders (8*s.* 6*d.*) per volume.

THE object of this work is explained by its title. It consists of a series of independent articles, each dealing with a more or less remote portion of the earth, and written by a man with years of field experience in that particular region. The contributors include representatives of several nations; most of them are well-known geologists, whose names are sufficient guarantee that full reliance can be placed on the advice that they give. All except two of the articles are in English; those two, on Indo-China and Morocco, being in French.

Of the three volumes now to hand (the first two of which are in their second edition), vol. 1 deals with the East Indies and South and East Africa; vol. 2 with various Arctic countries, and with Turkestan; and vol. 3 with Mexico, Indo-China, India, New Zealand, New Guinea, and Morocco. In some of the articles the treatment is much more detailed than in others, but from most of them information on the following subjects is obtainable: preliminary studies and arrangements, climate, means of transport, appropriate equipment, native servants, food-supply, and medical care. Various hints are given concerning the etiquette and idiosyncrasies of the native inhabitants, upon whose attitude the smooth running of expeditions in many lands will largely depend.

Any one about to visit one of the regions here dealt with on a survey or other scientific expedition can be recommended in all confidence both to study this work as a preliminary and to take it with him. He will not fail to derive many useful hints from a perusal, not only of the article relating to the particular country he is visiting, but also of those dealing with other comparable lands.

A Synopsis of the Families and Genera of Nematoda. By Dr. H. A. Baylis and R. Daubney. Pp. xxxvi+277. (London: The British Museum, 1926.) 10*s.* 6*d.*

THE Nematoda as a zoological division contains free-living as well as parasitic forms, and the number of the former is probably as great as, if not greater than, that of the latter. Yet the study of the parasitic forms, owing to their growing interest in relation to disease, has become more and more divorced from that of the free-living. The authors regard this growing separation

as indefensible and they have incorporated both groups in one system of classification. However sound this may be in theory, the result as shown in this volume is somewhat incongruous. The Nematoda are assembled into five orders in all, and the whole of the vast and varied assortment of free-living worms is included with Ascaris and Oxyuris in the single order Ascaroidea.

Apart from questions of classification, however, upon which there is much present-day difference of opinion, the work will prove a trustworthy and succinct guide to the various genera of roundworms together with the habitat usually taken up by the species of each genus and the name of its typical species or genotype. Under each genus is listed the papers most useful for reference. The general arrangement of the volume is admirable and should form a boon to the specialist; as, however, it does not list species, its use to the general reader is unfortunately limited. The year 1923 has been chosen as the closing date for the admission of new genera to the volume, and although a few names made since that date have been included, these are limited to synonyms of earlier genera or to new names to replace those already preoccupied.

The Fauna of British India, including Ceylon and Burma. Edited by Sir Arthur E. Shipley. (Published under the Authority of the Secretary of State for India in Council.) Birds. Vol. 3. Second edition. By E. C. Stuart Baker. Pp. xx + 489 + 7 plates. (London: Taylor and Francis, 1926.) 30*s*. net.

WITH the publication of this volume, which, like its two predecessors, deals solely with the Passeres, the author has brought to a conclusion his work on that great order of birds. In the three volumes issued up to date, 1336 species and subspecies have been recognised. In the first edition of the Avifauna, the Passeres were dealt with in two volumes, and the number of species then acknowledged was 936. The advance of ornithology has therefore given Mr. Stuart Baker much more ground to cover, largely owing to the necessity for his dealing with the numerous racial forms which have of late years been described.

The high standard set in the first two volumes has been fully maintained in the present one, which, in addition to numerous woodcuts, contains seven coloured plates by the author, that of the Zosterops being particularly pleasing.

The map of India which accompanies the volume would have been more instructive had the topographical features of the country been more clearly shown. The account of the birds of British India will probably be completed in three additional volumes.

The Statesman's Year Book: Statistical and Historical Annual of the States of the World for the Year 1926. Edited by Sir John Scott Keltie and Dr. M. Epstein. Sixty-third Annual Publication, revised after Official Returns. Pp. xxxvi + 1496. (London: Macmillan and Co., Ltd., 1926.) 20*s*. net.

EACH issue of this work of reference adds new features without sacrificing the old. The arrangement of countries remains the same, except that the kingdom of Hejaz has lost its place among the independent states. It is in regard to India that the principal changes occur. That section of the book has been expanded from forty-four to sixty pages, the increased space being devoted to the provinces of British India and the independent states over which the Indian Government exercises certain control. Each of these entities is now treated in the same way as the provinces of other parts of the Empire. Among the introductory matter, which includes a section on the League of Nations, new features are sections on the International Institute of Agriculture, a list of European and North African air routes, and tables showing taxation, national debt charges, and paper currency of various countries. The coloured maps are two, showing the distribution of republics and other political divisions in the Soviet areas in Europe and Asia. In spite of additions the bulk of the volume is not increased.

A Report on the Sugar Cane Mosaic Situation in February, 1924, at Soledad, Cuba. By Prof. Edward M. East and Prof. William H. Weston, Jr. (Contributions from the Harvard Institute for Tropical Biology and Medicine, 1.) Pp. vi + 52 + 9 plates. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1925.) 8*s*. 6*d*. net.

IN this, the first of a new series of publications from Harvard University devoted to tropical biology and medicine, an account is given of the mosaic disease of sugar-cane as seen by the authors on the Soledad estate, Cuba. The disease is thought to be of long standing in Cuba (unlike most of the British West Indies), but, at Soledad, it is not appreciably reducing the yield and quality of the Crystalina cane ordinarily grown in the island. The extensive bibliography, and the plates (some in colour) showing mosaic and certain other types of chlorosis in sugar-cane and maize, are useful features of the book.

Geography in School. By James Fairgrieve. Pp. x + 364. (London: University of London Press, Ltd., 1926.) 7*s*. 6*d*. net.

THERE is little that is new in this book, but there is nothing that is not said in an interesting way. Every thoughtful teacher of geography has faced the problems which the author discusses in the light of his long experience of school work, and no teacher could fail to derive something of value from what Mr. Fairgrieve has to say. Especially valuable is his insistence on reality in geography and his warnings of misunderstandings that are liable to be caused by the necessarily small scale of so many maps and the lack of personal knowledge of the world of most teachers. The book has a useful bibliography and full index.

Pression de la lumière. Par Pierre Lebedef. Traduit du russe par T. Kousmine. (Collection de monographies scientifiques étrangères, No. 9.) Pp. 71. (Paris: Albert Blanchard, 1926.) 7·50 francs.

PIERRE LEBEDEF devoted twelve years of his life to the study of the pressure of light, and this little monograph gives us, in a convenient form, a description of his experiments. The work practically consists of two papers, one on the pressure exerted by light on solids, and the other on the pressure on gases, the latter being important because of its application to the tails of comets. Some bibliographical notes are appended.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Muscular Action.

A NUMBER of papers by various writers have recently appeared on this subject, mostly dealing not with the action of the muscle itself but with the material consumed by its action and the products formed by their consumption. Taking the somewhat parallel case of an engine, the papers alluded to aim at describing what is put into the fire-box, what falls into the ash-pan, and what goes up the chimney. Nothing of any value, however, is said as to the nature of the engine, its efficiency, or how and why it performs its work. The function of a muscle is to exert a pull, and the pull depends on the shortening, or tendency to shorten, of the cells of which the muscular fibres are composed, when something is transmitted to them by the nerves.

One would like to know—What is it that the nerves transmit? And what is the origin and nature of the force which deforms or tends to deform and shorten the cells?

A nerve can be made to act on a muscle in many ways; by electric currents, for example, or by chemical or mechanical irritation, but this does not indicate the character of the natural stimulus any more than the fact that a pipe can convey power to an engine by carrying water or gas indicates the real nature of its contents.

Nervous stimulus involves the expenditure of work independently of the work done by the muscle in which it induces contraction. What is the proportion between these two expenditures? Again, as regards efficiency. Efficiency may be specified either as the over-all efficiency, by comparing the potential work in the fuel with that realised by the engine, or, what is more important as regards muscular action, by the work expended in the muscle compared with the realised external work.

When a muscle is in tension, work is expended whether the muscle remains stationary or contracts; but it is only during contraction that useful work is done, and the work consumed in keeping a muscle taut but stationary amounts to a leakage of power.

Does this leakage continue at the same rate for the same tension while the contraction is going on?

This might well form the subject of experiment, and were it determined it would be possible, for any particular case, to state the most efficient speed of contraction.

So far as is known, all the work done by the muscles in accelerating themselves and their attachments is wasted. In walking on a resilient level surface, for example, the whole of the muscular work is spent in this way, for the walker might perform the same journey in a frictionless carriage by merely starting it with a push the energy of which could be recovered at the journey's end.

It must not be assumed, however, that the whole of the acceleration of the leg in walking is supplied by muscular effort. The legs, like pendulums, have natural periods, and the muscular acceleration is that required to convert the natural period of the leg to the forced period of the step.

Letters touching on these questions have already been published in NATURE of April 15, 1920; June 3, 1922; and January 31, 1925.

A. MALLOCK.
9 Baring Crescent, Exeter, June 19.

Collisions of the Second Kind with Excited Mercury Atoms in the 2P State.

A NUMBER of experiments have recently been performed by various experimenters in which a mixture of gases containing mercury vapour as one constituent has been illuminated by light from a water-cooled quartz mercury arc. In interpreting the results of these experiments it has generally been assumed that the following process takes place. Mercury atoms first absorb radiation λ2536, an electron thereby being raised to the $2p_2$ state. Having reached this excited state the mercury atom may collide with one of the other atoms or molecules present and transfer its potential energy over to the other atom or molecule. The energy thus transferred may do one of several things. It may cause a molecule to dissociate; it may excite the colliding molecule or atom; it may all be changed into thermal kinetic energy of the two colliding bodies; or it may do combinations of the above.

In the interpretation of their results most of the experimenters have considered only the effect of mercury atoms in the $2p_2$ state. Recent experiments performed by the writer have shown that mercury atoms in the $2P$ state are also effective in the above process.

The apparatus and method were the same as used by Loria (*Phys. Rev.*, **26**, 573-584, Nov. 1925) with his sealed-off tubes. A mixture of zinc and mercury vapours was illuminated by the light from a water-cooled quartz mercury arc, and the following zinc lines were observed.

Wave length (Å U.)	Intensity	Notation.	Energy necessary to excite (volts)	Remarks
4810 4722 4680	8	$2p_{1,2,3}-1s$	6·63	Sharp triplet
3345? 3302 3282	2	$2p_{1,2,3}-3d$	8·48	Diffuse triplet
3075	5	$1S-2p$	4·01	Resonance line
2138	2	$1S-2P$	5·77	,, ,,

λ3345 is hidden by the mercury line λ3341. λ2138 was only obtained with long exposures.

When the exciting light was filtered through weak acetic acid (concentration 1 in 180) the zinc sharp triplet was reduced to an intensity of 2 λ2138 did not appear, but the exposure was not long enough to show definitely anything about this line. The intensities of the other lines remained very nearly the same. This weak acetic acid was found to absorb completely all wave-lengths shorter than λ2000 and to transmit λ2536 with nearly full intensity

When this mixture of zinc and mercury vapours was illuminated by the uncooled or hot mercury arc, the sharp triplet and a very faint trace of λ2138 appeared. The zinc diffuse triplet and the resonance line λ3075, if they appeared at all, did not have sufficient intensity to be seen on the plate. When the exciting light was filtered through weak acetic acid no zinc lines appeared.

These results may be interpreted as follows. When the mixture of zinc and mercury atoms is illuminated by light from the water-cooled mercury arc, some normal mercury atoms are raised to excited states by absorbing light. Some of them absorb λ2536, an electron thereby being sent to the $2p_2$ level. In this state the atom has a potential energy of 4·86 volts. Other mercury atoms absorb λ1849, an electron going

to the $2P$ level, giving these atoms a potential energy of 6·67 volts. Now, excited mercury atoms of either kind may collide with normal zinc atoms and transfer their potential energy to the zinc atoms, which are thereby raised to excited states. If an excited mercury atom has more energy than is necessary to excite a zinc atom, the energy remaining changes into thermal kinetic energy of the two colliding atoms. The excited zinc atoms returning to the normal state give out the zinc spectrum lines observed.

The energies necessary to excite these observed zinc lines are given in the table above. The only zinc line which a $2p_2$ mercury atom with its 4·86 volts energy could excite is λ3075, requiring 4·01 volts. A $2P$ mercury atom having an energy of 6·67 volts might excite either the sharp triplet requiring 6·63 volts or λ2138 requiring 5·77 volts. When we filter the exciting light through acetic acid, λ1849 is absorbed but λ2536 is transmitted. This means that no mercury atoms can now be raised to the $2P$ state, but about the same number can absorb λ2536 and reach the $2p_2$ state. As a result the intensity of the sharp triplet is much reduced, showing that it owed most of its existence to $2P$ mercury atoms. The zinc line λ3075 kept nearly the same intensity, showing that it depended principally on $2p_2$ mercury atoms.

When we illuminate by the hot arc, in which λ2536 is reversed, no mercury atoms will absorb λ2536 and be changed to the $2p_2$ state. However, we have some mercury atoms in the $2P$ state which have absorbed λ1849, and these collide with zinc atoms, causing them to emit the sharp triplet and λ2138. Now if we filter the light from the hot arc through acetic acid, λ1849 is absorbed and we have no excited mercury atoms present. Consequently no zinc lines appear.

There is some evidence that the zinc diffuse triplet requiring 8·48 volts is caused by mercury atoms in the $3d$ state. The discussion of this triplet will be reserved for the full report of this work.

It might be said that the zinc atoms could absorb λ1849 directly without the necessity of the intermediate $2P$ state of mercury. Powers (*Phys. Rev.*, **26**, 761-765, 1925) and Kapuscinski (NATURE, 116, 170 and 863, 1925) have found such a possible absorption for cadmium. In order to test this possibility, these experiments were repeated with a tube containing pure zinc and practically no mercury vapour. No zinc lines were obtained in any case.

These experiments show, then, that the effect of mercury atoms in the $2P$ state must be considered in the interpretation of the results obtained when any mixture of gases including mercury vapour is illuminated by a quartz mercury arc.

J. G. WINANS.

University of Wisconsin,
Madison, Wis., U.S.A., May 24.

Activated Fluorescence and Doppler Effect.

KLEIN and Rosseland deduced from thermodynamical considerations that an excited atom can, in consequence of a collision, fall into the normal state without emission of radiation (impact of the second kind). A part of the energy that becomes free can be spent in exciting the other atom, giving rise to the phenomenon of the "activated fluorescence" which was found to occur in mixtures of metallic vapours by Franck and his school.

For example, if mercury atoms which are brought into the $2p_2$ state by absorption of the 2537 line (corresponding to a potential of 4·9 volts) collide with atoms of another element possessing a lower resonance potential, the lines of this element are found to be emitted. The excess of energy must be distributed between the two atoms as kinetic energy.

As no direct proof of this latter point, so far as I know, has been given, I have tried to observe the speed acquired by the atoms as a Doppler effect, and I give here a preliminary account of the results, which agree also quantitatively with the theory.

I used a mixture of mercury and sodium vapours, contained in a bulb of fused silica, which was continuously evacuated by a diffusion pump. The mercury was put into a side tube, heated to 120°, so that the pressure of its vapour in the bulb was of the order of 0·5 mm. The bulb contained some sodium, and was heated to 300°-350°. On illuminating with the light of a water-cooled mercury lamp, a visible glow of D light appeared. The D lines were observed with a 40-plate echelon grating, and their breadth was measured with an ocular micrometer. It was found to be, as a mean value of six observations on D_1 and D_2, 0·16 Å.U. The lines were strongly reversed, the central part being absorbed by the sodium vapour before escaping from the bulb.

The breadth to be expected is easy to calculate. The kinetic energy must correspond to the difference $V_2 - V_1$ of the excitation potentials of mercury and sodium, *i.e.* to 4·9 − 2·1 = 2·8 volts; hence, and from the law of the conservation of momentum, we get the equations—

$$m_1v_1 = m_2v_2\ ;\quad \frac{m_1v_1^2 + m_2v_2^2}{2} = e(V_2 - V_1),$$

where m_1, v_1 and m_2, v_2 are the respective masses and velocities of the two atoms. The velocity of the sodium atom (which owing to its smaller mass absorbs nearly all the energy) is thus found to be $4{\cdot}3 \times 10^5$. The distribution of the velocities of the excited sodium atoms is uniform as regards the direction in space, but is not a Maxwellian distribution, because the molecules have all the same velocity. Hence it follows that the distribution of the intensity in the broadened line is quite different from that due to the ordinary Doppler effect of thermal agitation; and it is easy to see that our distribution must be a uniform one, with a breadth of the lines $\Delta\lambda = 2\lambda v/c$. Introducing for v the value given above, we obtain $\Delta\lambda = 0{\cdot}17$ Å.U., which agrees with the observed results within the limits of experimental error.

Also the distribution of intensity, so far as could be determined by eye observations, agreed completely with that predicted by the theory. To be sure that the broadening of the lines was due to the expected effect, I observed with the echelon spectroscope the D lines obtained by resonance in a bulb at the same temperature as in the previous research, illuminated with the light of a sodium vacuum lamp; the lines were found to be very narrow.

FRANCO RASETTI.

Firenze, Istituto Fisico dell' Università,
June 2.

High Frequency or Ironless Induction Furnaces.

IN an unsigned article in NATURE for May 29, entitled "High Frequency or Ironless Induction Furnaces," the writer suggests that his experiments on the heating of copper cylinders under certain conditions are at variance with the conclusions reached in our paper on this subject.

The statement in question was, ". . . consider the frequency which gives maximal (misquoted as "maximum") heating in several cases." Maximal in respect to what? Constant voltage applied to the inductor (!) or constant inductor current? (as the writer seems

to imply). He should have appreciated that neither condition was assumed.

We were considering maximal charge heating under constant power input to the inductor, and it was expressly stated that only inductors satisfying certain conditions were contemplated. The writer's experiments have no relation to the statement in question. Let us examine his experiments more closely.

We believe that the Ajax-Northrup inductor has 1·6 turns/cm.; then with 200 amp. at 50 cycles, a long cylinder of copper 5 cm. in diameter would absorb approximately 3 watts per cm. length. An elementary calculation indicates that this power would result in a temperature rise of 13° C. in 5 minutes—a temperature rise which might well escape the notice of hand-thermometry.

On the other hand, at 25,000 cycles, the power input would be 67 watts per cm. length into cold copper, and this, when account is taken of the large temperature coefficient of resistivity of copper, would in 8 minutes result in a temperature approaching 700° C.

It is important to remember that the resistivity of copper at its melting point is nearly six times its value at room temperature, so that the lowest frequency at which copper could be efficiently melted in 5 cm. diameter cylinders is about 220 cycles per second.

The fact that the charge has finite length will tend to increase the heating at the higher frequencies, and when it is borne in mind that the Ajax-Northrup converter produces damped waves ("containing all frequencies"), it will be realised that no very great precision can be claimed for these calculations. They are, however, more definite than the writer's statement of his inductor current—a statement more likely to satisfy the potential user than the physicist.

Again, regarding the exception which we have taken to Northrup's "fundamental statement" that at high frequency "the resistance of a charge is equal to its reactance," surely it is about time that this remark, which has appeared in technical papers for the last ten years, was laid to rest. Scientifically it is wrong; commercially it does not appear to serve any useful purpose, and even at the risk of being "noteworthy" we must continue to take exception to a "fundamental statement" by any authority when it is fundamentally incorrect. We must repeat that the ratio of resistance to reactance at high frequency is

$$\frac{1}{\sqrt{2\pi}\,.\,R}\sqrt{\frac{\rho}{p}}.$$

N. RYLAND DAVIS.
C. R. BURCH.

Research Department,
Metropolitan-Vickers Electrical Co., Ltd.,
Trafford Park, Manchester, June 3.

IN reply to the communication of Messrs. Burch and Davis, I have to say that:

1. The anonymity of the article was not of my seeking. My name was omitted owing to a misunderstanding.

2. I regret misquoting maximal as maximum. The use of the English equivalent did not, however, alter the meaning of the quotation.

3. The last paragraph of their letter evidently arises from some misinterpretation. In my article I pointed out quite legitimately that they took exception to a certain statement of Northrup's but made no comment, favourable or otherwise, concerning their attitude.

4. Implied criticisms concerning the accuracy of my measurements are out of place, since the experiments were intended to show, and did show clearly, that under practical conditions and at frequencies specified by the authors the heating effect on the copper charge was not merely less than some other value, but insignificant.

5. The authors state that only inductors satisfying certain conditions were specified. As it is impossible to construct inductors exactly complying with the theoretical conditions, their arguments are out of reach of rigid experimental verification. On the other hand, they arrive at certain general conclusions from which it can be deduced that an inductor current of, say, 25-50 cycles frequency would be suitable for heating a cold copper charge of 3 cm. radius. I endeavoured to check this conclusion experimentally at 50 cycles, and although a kilowatt was being dissipated in the inductor coil, no serious temperature rise of the charge took place in a period of 5 minutes. The inductor coil was designed for high frequency currents, and from this point of view the conditions were not favourable for the low frequency experiment.

The conclusions of Burch and Davis are so revolutionary, and if capable of practical application are so important, that I hope shortly to repeat the experiment, using an inductor specially designed for low frequencies. Such an experiment should determine if ironless inductive heating at these low frequencies is a practical proposition.

FRANK ADCOCK.

The Drop-weight Method of Measuring Surface Tension.

THE letter by Prof. Harkins on the above subject in NATURE of May 15 seemed to me to be very interesting. As, however, he has severely criticised my own views on the subject, I have thought it best to make some reply, for it is possible that a misunderstanding has arisen.

The method I adopted for calculating surface tension from the weights of drops of liquid falling from circular tubes is given in the *Philosophical Magazine*, vol. 45, p. 1088, 1923. I would refer any one interested to this paper, as it is quite unnecessary to reproduce any of the details here. The method was based on certain postulates which might replace Tate's laws in the greater accuracy with which they expressed the experimental facts, and which also seemed to lend a certain clarifying expression to the hopeless rigmarole that has been written round the subject for so many years. The fundamental operation in my calculations is certainly *not* taken from Harkins's work. I used certain data of Harkins and Brown (*Jour. Amer. Chem. Soc.*, vol. 41, p. 512, 1919), because at the time they were the most accurate I could find, and I saw no reason for repeating the experimental work unless I could be reasonably sure of a greater accuracy.

Harkins refers to my method as "cumbersome," "indirect," "involved," etc. The calculations could easily be shortened by the compilation of certain tables, but I do not understand why the ordinary mathematical operations of addition and multiplication should be "cumbersome" in my case and not in Prof. Harkins's. I suppose my method may be considered indirect because I have not followed in the tradition of certain formulation from which to the more conventional-minded it would be wrong to depart.

In ignoring the difference in gravity for Chicago and London, I have incurred an error in my results of 1 in 1000. It will be seen from my paper that I have merely given the figures for the surface tension correct to about 1 in 450.

Harkins's ingenious attempt to show that a drop hanging from a circular tube must inevitably satisfy

the equation $W = 2\pi r\gamma$ when the radius of the tube becomes extremely small, is not by any means conclusive, and does not seem to be supported by adequate experimental evidence. In any case, it could only be proved by extrapolation from a curve, and we should find ourselves involved in an argument as to whether the surface tension is the same for a thin mass as for the bulk of the liquid in all cases. The truth is that neither Harkins nor any one else has ever given a quite satisfactory solution of the dynamical problem of the drop detachment. His way out of the difficulty seemed to me to be somewhat vague and unsatisfactory; but that is only a point of view, and perhaps may not matter very much.

The main point at issue seems to be whether it is worth while checking any further propaganda on behalf of my method as opposed to Prof. Harkins's; and on this matter, of course, I have nothing to say. But I should be glad if Prof. Harkins would point out where my method is "erroneous," as at the moment I do not know what to make of his extremely general criticism, which occupies nearly two columns of this journal, and to which I can only make an equally indefinite reply. T. IREDALE.

Armstrong College, Newcastle-upon-Tyne.

Cirrus at a Lower Level than Alto-cumulus.

IN his letter to NATURE of February 6, 1926, p. 199, Mr. C. J. P. Cave has directed attention to the fact that well-defined cirrus clouds may occur at a much lower level than we generally assume to them, say, under a sheet of alto-cumulus. To support his view he describes a striking observation similar to that made by me on Sunday, June 13, at Strasbourg. During the morning and early afternoon of that day the weather was rainy and the sky covered with alto-stratus and nimbus. The nimbus ceased about 16.30 (G.M.T.) and the alto-stratus merged gradually into a sheet of fleecy alto-cumulus moving from west-south-west. It had a straight edge separating it from a beautiful clear sky.

At 17.30 I saw at an angular altitude of near 45° to the east-north-east a patch of well-defined white cirrus clouds under the alto-cumulus, and detached from them. As at the same moment many cirriform streaks were developing from alto-cumulus and acquiring the form of *cirrus-uncinus*, I believe the cirrus mentioned above may have been similar streaks afterwards separated from alto-cumulus.

Later, in the clear blue sky, some of these streaks were seen that had lost their *cirrus-uncinus* form. I am sure that if any one had observed the sky only at this moment he would undoubtedly have noted common cirrus, and there is no reason, I suppose, to say that they have not the same structure, as we know that in many cases high cirrus clouds are formed by snowflakes.

It is interesting to note that Mr Cave's observation and my own were made exactly with the same sky aspect; namely, a sheet of alto-cumulus with a straight edge and cirrus seen under it, near the edge. We are thus led to ask: Is all the low cirrus derived from alto-cumulus, and is it always seen near the edge of the sheet? The cirrus derived from the anvils of cumulo-nimbus seems to be an exception. The general meteorological conditions of the days of the two observations as regards cloudiness were also similar, the clouds being placed at the transition of a "corps" to a "traîne" of a "cloud system," using the modern French nomenclature. On January 24 a low pressure area was above western Scandinavia and another to the south-west of Iceland. These were fast-moving depressions with well-defined warm sectors passing over the British Isles. On June 13 a low-pressure area was situated to the west of Ireland, and it commanded in Europe a circular occlusions.

A revision is desirable of the altitudes assigned by the International Classification to the cloud forms, and also of the definitions of these forms, to take into account the new ideas of the structure and formation of clouds. ANTONIO GIAO.

Geophysical Institute,
38 Boulevard d'Anvers, Strasbourg (France),
June 14.

The Zoological Names *Simia*, *S. satyrus*, and *Pithecus*, and their Possible Suppression.

THE attention of the zoological profession is invited to the fact that the proposition is before the International Commission on Zoological Nomenclature to re-open the case of *Simia*. In its present form the proposition is for the Commission: (*a*) absolutely to suppress the generic names *Simia* and *Pithecus* and the specific name *Simia satyrus*, on the ground that retention of these names and the application of the rules to them will produce greater confusion than uniformity; (*b*) to insert into the Official List of Generic Names, *Chimpansee* Voigt, 1831, 76, for the chimpanzees *Pongo* Lacépède, 1799, type *pygmaeus* 1760, for the orang-utans, and *Macaca* Lacépède, 1799, type *sylvana* 1758, for the Barbary ape.

The argument before the Commission gives an extensive historical review of the subject; this will be published in Bulletin 145, Hygienic Laboratory.

Briefly summarised, the argument maintains: (1) that because of the importance of the Primates in connexion with investigations on infectious diseases, the nomenclature of certain genera has passed far beyond a status in which this subject is of importance only to zoologists in general and to mammalogists in particular; (2) that it is absolutely essential that unambiguous names be adopted internationally for experimental animals used for studies dealing with problems involving the life and death of human beings; (3) that the names *Simia*, *Simia satyrus*, and *Pithecus* are so confused in zoological literature as to preclude hope of reasonable uniformity in their use in zoological, bacteriological, serological, and public health work; (4) that the safest solution is to suppress these names entirely; (5) and that the International Commission should select thoroughly unambiguous and suitable substitutes which will preclude possibility of confusion in interpreting results as reported by bacteriologists and others in different countries—results which deal with human life.

The secretary will delay announcement of final vote until about September 1, 1927, in order to give to zoologists, bacteriologists, and others who may be interested, time to consult the premises formulated in Bulletin 145, and to express their views to the Commission. Application for copies of Bulletin 145, Hygienic Laboratory, should be addressed to the Surgeon-General, U.S. Public Health Service, Washington, D.C. C. W. STILES,
Secretary to Commission.

Hygienic Laboratory, Washington, D.C.

Names for Companion Stars.

I HAVE been expecting to see some comment in NATURE upon Sir Oliver Lodge's suggestion under the above title in the issue of March 13, 1926, but none seems to have appeared. It is not my purpose to dwell upon the propriety of naming so insignificant and dense an object as the companion to Sirius for

one whose contributions to science have been so large and brilliant. It is the suggestion regarding the companion to Algol that needs comment. Vogel's contributions to the art of measuring radial velocities put him in the first rank, but they do not include the discovery of the first spectroscopic binary. As this is an error that has often been repeated it may be well to set down the facts.

In his third annual report on the Henry Draper Memorial, published early in 1889 (our copy reached New Haven on April 16), E. C. Pickering states: "One photograph of Zeta Ursæ Majoris shows the K line distinctly double, and others show it single." In the January, 1890, number of the *American Journal of Science*, Pickering has an article dated November 12, 1889, in which he states that the K line in this star occasionally appears double, and he goes on to give what we now know to be the correct explanation, namely, that we are dealing with a binary, both components of which are bright.

At the meeting of the Prussian Academy of Science held on November 28, 1889, Vogel communicated six observations of Algol which show it to be a spectroscopic binary. These observations were first printed in *Astronomische Nachrichten* 2947 (dated January 11, 1890), in an article by Vogel dated December, 1889. Vogel's first observation of this object is dated December 4, 1888, while the duplicity of the lines in the spectrum of Zeta Ursæ Majoris was noted on a plate secured at Harvard on March 29, 1887. We see, therefore, that no matter what criterion is used to fix the epoch of the discovery of the first spectroscopic binary, we must conclude that the first of these objects to be detected was Zeta Ursæ Majoris by Pickering.

The above illustrates a difficulty which will be constantly met if Sir Oliver's suggestion is followed out; we should often be involved in matters of priority if these names are assigned during the lifetimes of the investigators concerned or too soon after their deaths.

FRANK SCHLESINGER.

Yale University Observatory,
June 4.

Energy Levels of the Carbon Monoxide Molecule.

IN their communication under this title in NATURE of July 3, p. 12, Messrs. Duffendack and Fox make a suggestion in connexion with the scheme of electronic energy levels of neutral carbon monoxide which I recorded in a recent letter. It is briefly, that there are two sets of levels involved corresponding to triplet and singlet terms in the corresponding atom. I would like to say that this and other suggestions were made to me by Prof Birge and Dr. Mulliken in private communications some three months ago, but too late for publication in my letter. It is clear that the whole scheme of levels can be interpreted on Birge's views, which are outlined in his important letter on "The Structure of Molecules" (NATURE, Feb. 27, 1926). The common ground level is $1S$. The initial levels of the 4th positive and the Ångström bands are respectively $1P$ and $2S$. The initial level of the Cameron bands is the triplet $1p_{123}$, and of the third positive bands is $1s$, while the new level which Duffendack and Fox postulate is probably $2p_{123}$. All the above levels have their counterpart in the corresponding magnesium atom, and the inferences which may be drawn therefrom account for all the facts.

The $3A$ positive bands of Duffendack and Fox are clearly the bands which I interpreted as an $n'=4$ sequence. The interpretation as arising from a $2p_{123}$ level is, however, preferable for two reasons: it avoids the anomalous intensity distribution in which the states $n'=2$ and 3 are absent, and secondly, the existence only of the states $n'=0$ and 1 is in harmony with recent work of Birge and Sponer on the heat of dissociation of the molecule. It may perhaps be added that not only are s to s transitions possible in band spectra but so also are p to p transitions (*e.g.* the $3A$ bands of carbon monoxide).

R. C. JOHNSON.

Department of Physics,
Queen's University of Belfast.

The Physical Basis of Insect Drift.

THE letter of Dr. E. P. Felt (NATURE, May 29, p. 755) illustrates how difficult it is in these days for the student of one science to keep in touch with developments in other sciences, developments which may have a considerable bearing on his own subject. We know all too little about the conditions in the upper air, but we know more than "the extremely few observations made by airmen in balloons, dirigibles, or aeroplanes." If Dr. Felt were to get in touch with the Weather Bureau at Washington, or with the Blue Hill Observatory, he would probably be able to obtain data which would be of great value in connexion with the question of insect drift. Observations of wind in the upper air are made as a matter of routine in many places in the northern hemisphere, and in some in the southern, so that there should be plenty of material to work on.

No doubt winds in the upper air have a great deal to do with the dispersal of insects, and convection currents occur at times up to much greater heights than those mentioned by Dr. Felt. At the same time there may be other factors besides wind; it is not easy to see how the extraordinary migrations of *Vanessa cardui* in Europe can be explained on purely meteorological lines unless other insects are similarly affected, which, so far as I know, is not the case. No doubt the appearance of *Colias edusa* in England from time to time might be explained by meteorological considerations, but if so a "clouded yellow year" should be a year when other continental forms appear here There is evidently scope for a considerable amount of team work between meteorologists and entomologists.

C. J. P. CAVE.

Stoner Hill, Petersfield,
June 17.

Abnormal Venous Circulation in a Frog.

ONE of our senior boys here, Alan Cadbury, when dissecting a frog, directed my attention to the fact that the right anterior vena cava appeared to be completely missing. Closer examination proved this to be actually the case In order to return the blood from the right anterior region of the body to the heart, a commissural vessel had been established connecting the bases of the external jugular vein of the two sides, the venous blood from the entire anterior region of the body thus finding its way back to the sinus venosus through the left anterior vena cava. The specimen was a well-grown male.

In a communication to NATURE of April 25, 1925, Dr. N. B. Eales has directed attention to variations occurring in the distribution of the anterior abdominal vein of the frog and remarked on their evolutional significance. No such significance can be plausibly attached to the present case, but the anomaly seems rare enough to be worth recording. The anterior abdominal vein opened into the liver as usual.

F. W. FLATTELY.

Leighton Park School,
Reading, June 10.

Oxidation, Passivity, and Corrosion.[1]

By ULICK R. EVANS.

WHEN a clean surface of metal is heated gently in air, a fine series of colours is often produced, the sequence of tints being that which would be expected from optical principles. In the case of lead, four 'orders' of tints can be observed: red, for example, occurs four times in the sequence. The transparent oxide film which is responsible for the effect can be lifted from the lead, and it is found that for any given film the colour as seen by reflected light is complementary to that seen by transmitted light. On copper and iron the sequence is essentially the same as on lead, but the fourth-order tints (corresponding to fairly thick films) cannot be seen; indeed on iron—no doubt owing to the low transparency of the oxide—only the first-order colours are really bright, although, if the oxidation is carefully carried out, the sequence can easily be followed as far as the third-order red.

It is important to notice that absolutely no change in the appearance of the iron occurs until the first yellow 'temper tint' arrives; this appears quickly at high temperatures, more slowly at lower temperatures. At ordinary temperatures iron can be kept in dry air indefinitely without undergoing visible change. It is generally considered that an oxide film is produced; but that, since diffusion of oxygen through an oxide is very slow at low temperatures, the film becomes protective, and ceases to thicken further, before it reaches the thickness needed to give the first (yellow) temper colour.

This view is supported by some experiments on the changes produced by oxygen on the chemical behaviour of electrolytic iron. The iron was very kindly prepared for me by Dr. W. H. Hatfield; it was fused *in vacuo* in a magnesia crucible before being rolled into sheet. When freshly ground, the iron was found to be capable of precipitating copper from $N/10$ copper nitrate solution within a few seconds. But after exposure for 21 hours to dry air or oxygen (freed from carbon dioxide) it was found to lose its activity, and drops of the copper nitrate solution then produced no effect even after standing on the surface for many hours. In other experiments, strips of the iron, freshly ground, were subjected to a temperature gradient in air or oxygen, so as to give a film of gradually increasing thickness, ranging at one end from thicknesses too small to give temper colours, through intermediate thicknesses displaying the three orders of tints, up to considerable thicknesses at the other end, where the scale had the slaty-grey appearance characteristic of magnetite.

On testing the films with small drops of copper nitrate, it was found that only a limited range of thicknesses afforded protection; this range was situated in the invisible region, and extended almost—but not quite—to the place where the first yellow tint commenced. At points near to the unheated end of the specimen, where the film was too thin to give protection, general deposition of copper quickly occurred. Near the heated end where the film was visible the protection also failed, but in a different way. Deposition of copper commenced at certain isolated points or lines, and spread out from these places over the oxidised surface. This copper was certainly deposited on the *outside* of the oxide film, since when the copper was afterwards dissolved away with ammonia the oxide film reappeared. The points around which deposition occurred almost certainly represented pores or cracks in the oxide scale; indeed, in the thicker scale, the cracks were sometimes visible. At a crack, the exposed iron would act as the anode of a local cell and the oxide around as cathode, copper being deposited on the latter without destroying it.

The behaviour of the part of the strips showing temper colours is of some interest. A short immersion in copper nitrate solution causes the tints to become dull, owing to the deposition of metallic copper upon the film (the colour of this copper can be seen if the specimen is held at a suitable angle); at the same time, the tints shift in a direction which would seem to indicate a thickening of the film at each point. If, at this stage, the copper is dissolved away with ammonia, the colours re-emerge with practically undiminished brightness. If, on the other hand, the strip is kept in the copper nitrate solution until the colours are completely hidden by a thick deposit of pink copper, the colours, when the copper is dissolved away by ammonia, reappear distinctly weaker than before.

Analogous results are obtained when copper strips, covered with an oxide-film of varying thickness, are treated with dilute silver nitrate, although on copper the protective power of an oxide skin is much less permanent than in the case of iron. The maximum resistance is again situated in the invisible region, but the films thick enough to give first-order tints resist the reagent for almost as long a time. As in the case of iron, the thick films fail in quite a different manner from the very thin films; on the thick films tiny isolated crystals of shining silver appear, no doubt at the sites of pores, whilst where the film is very thin general deposition of darker silver occurs.

Both on iron and copper the behaviour of the oxide-film in protecting the metal varies *gradually* as the thickness is increased: there is no sharp change at the point where the first visible tint appears. This observation has a bearing on the cause of the 'passivity' displayed by iron which has been treated with oxidising agents. Some authorities have maintained that this cannot be due to a protective film, basing their argument on the facts (1) that no film is visible on passive iron, and (2) that iron covered with a visible film is not, as a rule, passive. These particular objections to the oxide film theory would seem to possess but little weight. The poor protection afforded by relatively thick visible films is almost certainly due to the increase in the probability of spontaneous cracking which accompanies an increase in thickness. Clearly, however, the conditions of formation of the film greatly affect the protective character; some oxidising agents, for example, seem to give more reliable films than oxygen itself. It is, of course, possible that other causes besides the presence of a film on the iron might

[1] Based on two lectures on the "Tinting, Tarnishing, and Corrosion of Metals," delivered at the Royal Institution on May 20 and 27.

give rise to the phenomenon known as passivity; but all the cases so far examined by the present writer appear to be due to protective films.

It is well known that solutions of oxidising agents, such as chromates, render iron passive towards copper salts. In the case of electrolytic iron this passivity can also be brought about by dissolved oxygen, provided that it is present in sufficient quantity at all points on the surface. Since oxygen is not very soluble in water, some special arrangement is needed to ensure the oxygen supply to the point where the specimen is supported. This can be attained by using the "eccentric whirler" recently described by the writer [2]; the specimen, consisting of a metal disc pierced centrally with a circular hole, is slipped over a glass tube blown to bulb-form at the lower end, and attached eccentrically on a vertical spindle, which can be driven by a motor. When the spindle rotates, the whirling disc mounts the tube and the point of contact with the glass alters from one moment to the next; thus there is no fear of oxygen exhaustion at the point of support. If a disc of mild steel is thus 'whirled' in distilled water containing oxygen, it soon attains a yellow appearance, due to the formation of adherent ferric hydroxide over the surface generally; [3] if taken out after 100 minutes, dried and tested with copper nitrate, the iron is found to blacken within a few seconds. When, however, the experiment is repeated with electrolytic iron, quite different results are obtained. It is found that this material develops rust only in minute spots, between which the metal remains bright; the spots probably represents the sites of pores in the metal into which oxygen cannot rapidly penetrate; only a trace of iron passes into solution. If the specimen is taken out after 100 minutes 'whirling,' the iron is found to be quite passive towards copper nitrate. Some specimens of electrolytic iron have been found to remain free from rust altogether when whirled for many hours in water containing oxygen, probably because they were free from pores.

It should be understood that the comparatively non-rusting behaviour of electrolytic iron only refers to conditions of *uniform aeration*. If the same iron is exposed in the same water under conditions of *differential aeration*, rusting occurs readily. Thus if a strip of electrolytic iron be partly immersed in a nearly vertical position in the water, so that oxygen reaches the upper part more easily than the lower part, corrosion quickly commences; it is plainly visible after 30 minutes. Iron passes into solution at the points where the oxygen-concentration is lowest as the comparatively soluble ferrous hydroxide, and although this will ultimately be oxidised to the much less soluble ferric hydroxide (the main component of 'rust'), the ferric hydroxide, being formed as a secondary product at an appreciable distance from the seat of origin of the ferrous hydroxide, does not form a continuous film over the metal and has no protective character.

The setting up of corrosion by differential aeration is well shown by experiments on the behaviour of steel in contact with sodium chloride solution. When a drop of salt-water is placed on a sheet of mild steel, corrosion occurs in the centre of the drop; the peripheral portion of the drop—the part which oxygen can reach most readily—remains quite uncorroded. Similarly, if a strip of steel be partly immersed in sodium chloride solution, corrosion occurs over the portions well below the surface; just below the water-line there is a zone of quite uncorroded metal.

Experiments have shown that the corrosion is connected with electrical currents set up by the variation in oxygen concentration; the portion where the oxygen concentration is lowest functions as the anode, or corrodible portion. These currents only flow if oxygen is supplied continuously to the cathodic area, but they produce corrosion upon the part which is not directly reached by the oxygen. The mechanism would appear to be as follows. Oxygen reaches the portion next to the water-line and causes a kind of passivity. The potential is raised above that of the lower, relatively unaerated, portions, and this determines the flow of current; measurements by McAulay and Bowden [4] have shown that the potential over the aerated zone may become so much as 0·2 volt 'nobler' than that of the unaerated zone. The unaerated portion suffers anodic corrosion yielding ferrous chloride, whilst at the aerated portion the cathodic reaction produces sodium hydroxide; along the line where the ferrous chloride and sodium hydroxide meet, we get white ferrous hydroxide, rapidly oxidising through the green intermediate body, to brown ferric hydroxide, and thus a membrane of rust is produced at the junction of the anodic and cathodic regions. Thus the *direct* effect of oxygen is to produce a species of *passivity* at the points actually reached by it; but the *indirect* effect is to cause *corrosion* at the points not reached directly.

The corrosion set up by these differential aeration currents becomes most serious when the unaerated anodic area is much smaller than the aerated cathodic area, since then the whole effect is concentrated on a limited surface, and the rate of penetration downwards will be quite rapid. If a minute cavity exists in the metal and becomes filled with liquid, this will be relatively inaccessible to diffusing oxygen, and will therefore become anodic to the main portion of the surface; the attack will here quickly eat down into the metal, causing 'pitting.' The mouth of the pit will become covered with a loose hump or blister of rust, due to interaction of the anodic and cathodic products, but since this rust is not formed *in situ* at the anodic area, it will not protect the metal from corrosion; on the contrary, by shielding the interior of the pit from oxygen, it will, for a time, tend to promote the attack. Thus, when once pitting has commenced, it is difficult to stop it.

Differential aeration currents probably constitute the most serious practical cause of corrosion of zinc, iron, steel, lead, and aluminium articles. But electric currents set up in any other way will cause corrosion, provided that the immediate anodic and cathodic products are soluble bodies; where—as in the case of lead in a sulphate solution—the direct anodic product would be an insoluble compound, there is comparatively little attack.

Numerous other ways of generating these corrosion

[2] American Chemical Society Corrosion Symposium, 1925. See *Ind. Eng. Chem.*, 17, 1925, 370.

[3] This yellow colour is due to the characteristic tint of ferric hydroxide, and in no way resembles the yellow temper colour.

[4] *J. Chem. Soc.*, 127, 1925, 2605.

currents are known. In the case of copper, if water is moving rapidly over the surface at one place and is comparatively stagnant elsewhere, the copper ions will be carried away more quickly from the point of rapid motion than from the rest of the surface, and therefore a concentration cell is set up; the point of rapid motion is anodic and suffers corrosion. Where a material consists of two phases, a current may flow between these two phases, even when the composition of the liquid is the same everywhere. This is possibly the reason why—as mentioned above—a steel disc suffers alteration even under conditions of uniform aeration; for though—by whirling—we may diminish or even eliminate differential aeration currents, we can still get currents set up between the iron and carbide particles of the steel. Owing to the fact that under conditions of whirling the individual anodic and cathodic areas are of microscopic, instead of macroscopic, size, the hydroxide is precipitated close to the surface, and tends to cling to it. Thus the rust produced under these conditions of uniform aeration is far more adherent than that produced by differential aeration.

Climatic Changes during Geological Times.[1]

By C. E. P. BROOKS.

II. CAUSES OF GEOLOGICAL CHANGES OF CLIMATE.

THE preceding article closed with a discussion of Wegener's theory of continental drift. That theory is still *sub judice*, but it was pointed out that even if it be ultimately accepted, it does not solve the problem of climatic changes. Köppen and Wegener themselves recognise this, for they adopt astronomical changes as an explanation of glacial and interglacial stages, and suggest also that astronomical changes may have been important in the Tertiary succession of Europe. Apart from this, however, any one looking at Wegener's reconstructions and remembering the way in which the land and sea distribution at the present day dominates the local distribution of climate, cannot but realise that these extensive rearrangements must have brought about corresponding changes of climate, quite apart from those due to the supposed changes of latitude. Köppen and Wegener implicitly assume that the distribution of climate depends only on the distribution of solar heat at the outer limit of the earth's atmosphere, but even if the radiation from the sun be supposed to have remained constant, there are many factors of climate other than the astronomical conditions. These factors have been discussed in a large number of books and papers which include some very brilliant work. This great mass of literature is surely worth a thought.

In the middle decades of the nineteenth century, when radio-activity had not been discovered and pre-Quaternary glaciations were a heresy, the earth was believed to be cooling from an original molten state and the uniform warmth of the earlier geological periods was attributed to this earth-heat. In this scheme of things the Quaternary glaciation—"The Great Ice-Age"—marked the gap between the waning of earth-heat and the assumption of full control by the sun. This primitive view is no longer tenable, but still it occasionally crops up, as in the ingenious speculations of Marsden Manson, who supposes that the internal heat maintained the oceans at a high temperature, thus giving rise to a dense mantle of cloud which shut out the heat of the sun. The earlier ice-ages were due to local cooling in the centres of the great continents, the Quaternary to the final cooling of the seas, while the introduction of the present zonal distribution occurred when the last remnants of the universal cloud layer broke down.

Another early theory of climatic changes, variations in the heat received from the sun, perished from lack of evidence. Dubois attempted to bolster up his hypothesis that during the Quaternary glaciation the sun was a red star by arguments from colour blindness regarded as an ancestral trait belonging to the time when the earth was bathed in a perpetual sunset glow. Other views attributed the Quaternary ice-age to the shutting out of the sun's heat by a cloud of cosmic dust, and one ingenious theory gives us an ice-age for the birth of each planet between the earth and the sun. Recently Huntington and Visher[2] have attempted to revive the theory of solar control. Starting from the accepted view that the earth is slightly warmer at minima of the eleven-year sunspot period than at maxima, and the controversial view that storminess increases from minima to maxima of sunspots, they suppose that the warm periods were times of few sunspots and the ice-ages times of many sunspots. Such an enormous extrapolation from a small and imperfectly understood basis would not be warranted unless supported by convincing evidence. At present we know nothing of the variations of solar activity during the geological past, and even if the variations which Huntington and Visher postulate have actually occurred, it is improbable that they would have the results which are attributed to them.

Whatever may be the case with the total radiation received by the earth in a year, there can be no doubt that its distribution in seasons and latitudes has varied greatly with changes in the obliquity of the ecliptic and in the eccentricity of the earth's orbit. The idea that these changes were responsible for geological changes of climate is very old, but it was not until the appearance of Croll's brilliant essay, "Climate and Time," that they won general respect. Croll supposed that the most favourable conditions for glaciation occurred during times of great eccentricity, and were located in the hemisphere with winter in aphelion, the short hot summer being insufficient to melt the accumulated snowfall of the long cold winter. Murphy first pointed out that the reverse was more likely to be true, and subsequent research has confirmed Murphy's view. Although the total quantity of heat received over a whole hemisphere in a year is not affected by astronomical changes, this is not true of individual belts of latitude, and in high latitudes more heat is received in the course of a year when summer falls in

[1] Continued from p. 17.

[2] Huntington, Ellsworth, and Visher, S. S., "Climatic Changes: their Nature and Cause." New Haven, 1922.

perihelion than when summer falls in aphelion. Moreover, the summer conditions are of greater importance for glaciation than are the winter conditions.

This astronomical theory of climatic changes has to face two great difficulties. First, it requires glaciation to alternate in the northern and southern hemispheres, while geologists believe that glacial stages have been synchronous over the whole world; and secondly, the astronomical time-scale is incompatible with the geological time-scale as set out in the absolute chronology of de Geer. Recently, means have been found to overcome the first of these difficulties; thus R. Spitaler,[3] after an elaborate computation of the temperature of land and sea in different latitudes under a great variety of astronomical conditions, considers that each stage of the Quaternary ice-age represents a time of maximum eccentricity covering several precession periods of 21,000 years each, the ice-sheets advancing when aphelion fell in spring or summer and retreating when aphelion fell in autumn or winter, but being able to persist through the whole stage owing to the general cooling of the oceans. Spitaler's scheme, however, requires much more time than the geologists will allow. W. Köppen[4] attributes a similar persistence to the cooling introduced by the ice-sheets themselves; on the basis of calculations by M. Milankovitch, in which the heat received in summer is regarded as the essential variable, he achieves a more moderate time-scale, which, however, still presents several difficulties. Thus Spitaler and Köppen make the main glacial stages synchronous in each hemisphere, but with secondary maxima at different times. The astronomical theory has this in its favour, that we can be reasonably certain that the postulated astronomical changes have occurred. But if they were of such dominant importance during the Quaternary, it is curious that they have not been recognised in the climatic alternations of earlier geological periods—for example, there should have been several ice-ages at intervals during the Tertiary. If until the Quaternary they were masked by much greater effects due to non-astronomical factors, why not attribute the Ice-Age itself to the latter also?

The interval between the founding of the astronomical theory by Croll and its recent revival has witnessed the birth and death of the carbon dioxide theory, introduced by Arrhenius[5] in 1896 and taken up by F. Frech, T. C. Chamberlin and others. The theory is that carbon dioxide acts like the glass of a greenhouse, allowing the sun's rays to reach the earth's surface almost unchanged, but absorbing the greater part of the return long-wave terrestrial radiation. Subsequent research has shown, however, that water-vapour has exactly the same properties, and that there is always sufficient water-vapour present to absorb practically all the radiation which would be taken up by carbon dioxide, so that the latter can play only a very minor rôle.

Chamberlin introduced another remarkable conception—the reversal of the oceanic circulation.[6] Ocean currents are due to three causes, differences of temperature in different parts of the surface, differences of salinity, and the action of the wind on the surface layers. At present the latter cause predominates, the warm surface waters of the tropical oceans being driven westwards and then polewards by the prevailing winds. Chamberlin supposed that at times the evaporation in the inter-tropical regions was so great that the surface layers, owing to their increased salinity, became heavy enough to sink to the bottom, where their heat was conserved as they spread polewards, until they emerged in high latitudes and brought about mild polar climates. The chief objection to this is that great evaporation implies also heavy rainfall, while the periods in which the mild polar climates prevailed are marked by aridity in middle latitudes.

Somewhat less sensational variations in the system of ocean currents have frequently been adduced as causes of climatic change. The remarkable difference of climate between the British Isles and Labrador is usually attributed to the fact that the former are washed by the warm Gulf Stream Drift, the latter by the cold Labrador Current, and it has been supposed that the opening of a gap between North and South America, by allowing the warm water of the Guiana Current to pass through into the Pacific, caused the Quaternary ice-age in Europe. This particular conclusion is not warranted by the premises, but from the great differences of climate which can exist between places along the same parallel of latitude, it is obvious that the redistribution of land and sea may account for considerable changes of climate. This was the view of Lyell, who attributed the Quaternary ice-age to an expansion of the tropical oceans, from which much water was evaporated, and in high latitudes an extension of the land areas, on which the water-vapour fell as snow. Similarly, W. Ramsay[7] has insisted on the importance of high ground in lowering the temperature, not only locally but also over the whole world. Such ideas must remain speculative, however, until they have been supported by an adequate numerical basis.

F. Kerner has done more than any one else to calculate what effect a given change of land and sea distribution would have on the local and general temperatures; his results show that geographical changes go a long way towards accounting for the climatic vicissitudes of Europe during the Tertiary,[8] but he failed to account for the mild Arctic climates of the Jurassic and Eocene, his calculated January temperatures for the 75th parallel being nowhere above the freezing-point.[9] One of Kerner's papers, however,[9] contains a suggestion of what may ultimately prove to be the most important factor in climatic changes, namely, the cooling power of an ice-covered polar ocean. Brooks had previously shown a similar cooling power of land ice; when an ice-sheet reaches certain dimensions, the cold ice-winds bring the neighbouring land below the snow line, and the process continually repeated enables the ice-sheet to grow to very large dimensions. Calculations show that the extension of

[3] Spitaler, Rudolf, "Das Klima des Eiszeitalters." Prag, 1921. (Lithographed.)

[4] Köppen, W., und Wegener, A., "Die Klimate der geologischen Vorzeit." Berlin, 1924.

[5] Arrhenius, Svante, "On the Influence of the Carbonic Acid in the Air upon the Temperature of the Ground," *Phil. Mag.*, **41**, 1896, p. 237.

[6] Chamberlin, T. C., "On a Possible Reversal of the Deep Sea Circulation and its Influence on Geologic Climates," *Jour. Geol.*, **14**, 1906, p. 363.

[7] Ramsay, W., "Orogenesis und Klima," *Öfvers. Finska Vetensk. Soc. Förh.*, **52**, 1910; "The Probable Solution of the Climate Problem in Geology," *Geol. Mag.*, **61**, 1924, p. 152.

[8] Kerner, F. "Synthese der morphogenen Winterklimate Europas zur Tertiärzeit." Wien, 1913.

[9] Kerner, F., "Das akryogene Seeklima und seine Bedeutung für geologischen Probleme der Arktis." Wien, *Sitzungsber. Ak. Wiss.*, **131**, 1922, p. 153.

the Scandinavian ice to England, and the rapid collapse of the ice-sheets at the close of the Quaternary glaciation, are accounted for by this effect. A floating polar ice-cap can be dealt with in the same way; at the close of a warm period the ocean will remain entirely free of ice until the temperature falls to freezing-point in winter. A small further fall, and a floating ice-cap will spread over the whole of the polar ocean. Kerner's and Brooks's calculations indicate that a general rise of temperature by 5° F. persisting over many years would suffice to render the whole Arctic Ocean non-glacial, a change which would reverberate over the whole globe.

This idea entirely alters the scale of the problem. Many factors which are inadequate to account for the temperature change of some 40° F. in the polar and cold temperate regions between an ice-age and a warm period may easily account for a change of 10° F., the remaining 30° being due to the cooling power of land ice and sea ice. Only two types of climate are possible, the 'non-glacial' or warm and the 'glacial' or cold. The transition from one to the other may be due to any of the climatic factors which have been so ardently advocated, but the close association between cold climates and mountain-building suggests the dominance of geographical causes. After a major orogenic period the continents are high and extensive, the ocean currents are restricted, and perhaps volcanoes send out large quantities of dust to interfere with the free passage of the sun's rays; all these causes, combined perhaps with unfavourable astronomical conditions, lower the amount of heat reaching high latitudes, so that the temperature of the polar oceans falls below the freezing-point in winter and a floating ice-cap is formed. After a long period of rest and erosion, the continents are low and small, there is a free oceanic circulation, and volcanoes are unknown; so much heat reaches high latitudes that the polar oceans are above the freezing-point even in winter, and there is no ice.

What of the Upper Carboniferous glaciation of the tropics? The geographical theory can be indicated only briefly; it postulates a high plateau, with a cold ocean to the south, a warm ocean to the north, and a permanent 'south-west monsoon' blowing from the former to the latter, covering the plateau with a dense layer of low cloud which with the assistance of a volcanic dust veil reflected a large proportion of the sun's rays back to space and kept the temperature low enough for snow to fall abundantly above a level of about 6000 feet, giving rise to ice-sheets which reached the sea. Whether the difficulties which confront this theory are greater than those confronting the theory of continental drift which is its only alternative, time will show.

Recent Developments in the University of Sheffield.

ON July 1 and 2 the University of Sheffield celebrated the twenty-first anniversary of the granting of its charter of incorporation. Congratulatory addresses were presented by sister universities throughout Great Britain and the Dominions, scientific and other institutions and societies, and public bodies. Among the recipients of honorary degrees may be mentioned H.R.H. Princess Mary, Lord Derby, Sir Austen Chamberlain, Sir Charles Eliot, Prof. P. F. Frankland, and Engineer Vice-Admiral Sir Robert B. Dixon. New engineering and metallurgical laboratories were formally opened by Sir Robert Hadfield, and the numerous delegates and other visitors were afforded an opportunity of acquainting themselves with the work of the various departments.

The University of Sheffield received its charter twenty-one years ago, but the history of the institutions out of which it grew goes back much further. The Technical School, the germ of the present Applied Science Department, was founded in 1886; Firth College, from which the faculties of arts and pure science took their origin, dates from 1879; while the Medical School will be able to celebrate its centenary in 1928. These three institutions united in 1897 to form the University College of Sheffield, which received full university status in 1905. The history of the University during the past twenty-one years has been one of almost unbroken progress in every direction. The numbers of its students and staff have greatly increased, especially since the War; the amount of research work carried on within its walls has grown steadily; new departments and courses have been established as the need for them arose and the resources of the University permitted; and generous financial support has been received from private and public sources. Though a complete survey of recent progress is not possible here, a few notes on the main lines of development may perhaps be not without interest.

The most rapid and extensive progress in recent years has taken place in the Department of Applied Science, which includes the faculties of engineering and metallurgy, and a number of associated departments. Expansion in these branches has been made possible largely by the growing recognition in industrial circles of the importance of technical training and scientific research. Thanks to the generous support of leading Sheffield industrialists, the departments of the faculty of engineering have been able to make several important additions to their resources. The Edgar Allen and Jonas Research Laboratories, opened in 1923, are designed respectively for research in magnetism, magnetic properties of materials, and allied subjects, and for investigations on the mechanical properties of materials. Further provision for research in this latter subject has been made in the new laboratory opened by Sir Robert Hadfield on July 2, which is being used at present for work on the effects of high temperatures, heat treatments and repetition stresses, but can be adapted, as the need arises, for the investigation of many other engineering problems. All these new laboratories are equipped with the most modern machines and apparatus, constructed in many cases in the engineering workshops.

One of the most important post-War developments is the establishment, in association with the faculty of engineering, of a Department of Fuel Technology. This

is essentially a research department, and the majority of its students are honours graduates in chemistry. It co-operates closely with the mining and metallurgical departments, and has entered into a working arrangement with the Safety in Mines Research Board and the Fuel Research Board, whereby the facilities for research work at the disposal of each body are shared mutually, and the respective staffs engage in conjoint work. Among the subjects that have particularly engaged the attention of the department have been the properties and production of blast-furnace coke, the constitution and properties of coal, and problems of gaseous combustion.

The Mining Department, an integral part of the faculty of engineering, has also made rapid progress, especially on the research side of its work, which has dealt chiefly with flame-proof electrical apparatus, coal-cutter steels, winding and haulage ropes, and mine ventilation. The Department has co-operated with the Safety in Mines Research Board and with the mining industry of the surrounding area. Its work has grown to such an extent that the present accommodation is inadequate, and a scheme is in hand for the erection in the near future of an entirely new mining department.

No account of the progress made in applied science would be complete without a reference to the Department of Glass Technology, which is equipped with a complete glass works, and laboratories in which a large body of research has been carried out. In connexion with the Department there has been formed the Society of Glass Technology, with a membership of about 650, distributed through twenty-two countries.

The faculty of metallurgy has existed separately since 1917, but the subject has played a leading part in the activities of the Applied Science Department since its earliest days. Owing to the nature of the chief industries of Sheffield, the needs of which it was originally created to serve, the faculty chiefly concentrates on the metallurgy of iron and steel, and it is now the best equipped in the country for work in this sphere. Recently, in response to the growing interest in scientific research among the lighter industries of the city, increasing provision has been made for non-ferrous metallurgy. A notable feature of the activities of the Department is the close association of practical training with theoretical instruction. Its equipment includes a complete steel works, fitted with plant of sufficient capacity to produce open-hearth, crucible and electric steels for the use of both the Metallurgical and Engineering Departments. Recent developments include the provision of a new laboratory designed specially for post-graduate research work on the physical properties of steel, and the institution, with the aid of a grant from the Department of Scientific and Industrial Research, of research work on electro-deposition, which will be of great importance to the Sheffield plating trades. Other Government departments and research associations maintain research workers in the metallurgical laboratories.

Though the rapid expansion of the Applied Science Department has been a notable feature of the recent history of the University, considerable development in other directions can be recorded. There has been a great increase in both teaching and research work in the faculty of pure science. Chemistry has had to extend its laboratory accommodation by the erection of a large hut in the quadrangle, and there has been a steady output of research, carried out largely with the aid of students, which has been concerned mainly with investigations on the reactivity of substituents in the benzene nucleus, the remarkable isomerism of diphenyl derivatives, and adsorption by porous bodies. Physics also has been compelled to provide for its enlarged teaching work by the erection of a hut, and has further acquired four new research rooms. The research work carried out in the Department has followed the line, laid down originally by Emeritus Prof. W. M. Hicks, of specialisation in spectroscopy, and a very considerable equipment in this branch of physical study has been gathered together.

In the faculty of medicine three recent developments are worthy of notice. There have been, in the first place, changes in the curriculum and organisation of the faculty, with the object of bringing both its teaching and research work into closer contact with the city hospitals. Anatomy and physiology, formerly taken for the second M.B., Ch.B. examination, have been extended into the third M.B., Ch.B. course, and thus, during the third and part of the fourth year, theoretical work in these subjects is carried on simultaneously with clinical training. A series of posts in physiology and pathology, the holders of which work both in the University and in the hospitals, has been created. An important part in linking up the teaching work of the University with the clinical part of the medical course is played by the Department of Pharmacology, established in 1921, which has devoted itself to extensive investigations on subjects of combined laboratory and clinical interest. In addition to the accommodation at the University, the Department possesses a field laboratory in the country, specially created for experimental work on nutritional and other problems. The opportunities for medical research provided in the Department have resulted in a large output of work, including amongst other subjects the etiology and treatment of rickets, the factors of diet and environment responsible for the structure of the teeth, conditions controlling the rate of development of caries in children, the treatment of exophthalmic goitre, the action of alcohol and the toxic action of cereals. The third line of development in the medical work of the University has been the re-establishment of the dental school, in connexion with which new laboratories, provided with the most modern equipment for the teaching of dental mechanics, have been opened. A complete course of instruction for degrees and diplomas in dental science has been arranged, and hospital accommodation for clinical work is provided.

The foregoing notes, though they mention only the most important developments of recent years, show that Sheffield has taken its place side by side with the other universities of Great Britain, as an institution actively engaged both in the propagation and in the expansion of knowledge. The main lines of expansion which it is destined to follow are laid down, and further progress may confidently be expected as funds become available.

News and Views.

THE King's birthday honours list, publication of which was delayed on account of the General Strike, was issued on July 3. It includes the following distinctions conferred in recognition of scientific services or association with scientific work:—*Privy Councillor*: Sir Halford Mackinder—chairman of the Imperial Shipping and Imperial Economic Committees and first Principal of University College, Reading, now the University of Reading. *K.B.E.*: Sir Frank W. Dyson, Astronomer Royal; Prof. W. Somerville, late Sibthorpian professor of rural economy, University of Oxford. *D.B.E.*: Dr. Mary A. D. Scharlieb, consulting gynæcologist, Royal Free Hospital. *Knights*: Colonel H. G. Lyons, Director and Secretary of the Science Museum; Dr. Brajendra Nath Seal, Vice-Chancellor of the University of Mysore. *C.B.* (*Civil Division*): Dr. G. C. Simpson, Director of the Meteorological Office; Mr. F. E. Smith, Director of Scientific Research, Admiralty. *C.M.G.*: Dr. A. W. Hill, Director, Royal Botanic Gardens, Kew, Mr. J. O. Shircore, Director of Medical and Sanitary Services, Tanganyika Territory. *C.B.E.*: Mr. A. Abbott, Chief Inspector of Technical and Continuation Schools, Board of Education. *O.B.E.*: Mr. E. W. Wallis, secretary of the Royal Sanitary Institute. *I.S.O.*: Mr. D. d'E. de Charmoy, Assistant Director and Entomologist, Agricultural Department, Mauritius; Mr. A. R. Wright, assistant comptroller, Patent Office.

THE Commonwealth House of Representatives has passed two Bills dealing with the reconstitution of the Institute of Science and Industry. The Bills received the hearty approval of members on all sides of the House, the sole complaint from the Opposition (Labour) being that their introduction had been unduly delayed. The first Bill outlines the scheme of reorganisation, which abolishes the former directorship and provides for a central council composed of three members appointed by the Governor-General (who will constitute an executive committee and exercise all the powers of the council between meetings), the chairman of the six State advisory committees, and such other members as the council may desire to co-opt on account of special scientific knowledge. A sum of 250,000*l.* is appropriated for the purposes of the council, and this will ensure that for the first few years its programme will not be subject to yearly modification to accord with the exigencies of the Treasury. The name "Institute of Science and Industry" has been discarded, and the body will in future be known as the "Council for Scientific and Industrial Research," which is more in accord with British and Canadian practice. The second Bill establishes a Trust Fund of 100,000*l.*, the income from which is to provide assistance (*a*) to persons engaged in scientific research, and (*b*) in the training of students in scientific research. Considerable progress has already been made by the executive committee in the preparation of proposals for the first session of the new council, which will commence on June 22. It is hoped to establish very close relations with the British Department for Scientific and Industrial Research, and to that end the chairman of the executive committee (Mr. G. A. Julius) will visit Britain towards the end of this year.

THE Mellon Institute of Industrial Research is a good example of what can be done by the co-operation of enlightened manufacturers and by able administration. Its system of industrial fellowship was initiated in 1906, and although this remained in the experimental stage for nine years, since 1915 it has been in a strong position both financially and administratively. Dr. E. R. Weidlein, the director, states in his recent report that fifty-four of these fellowships, employing ninety-four research chemists and engineers, were held in the Institute during the year ended February 28, 1926, and that more than 125,000*l.* was contributed for their maintenance by the fellowship donors. The total sum of about 775,000*l.* has been received from companies and associations during the last fifteen years. In a separate document the Institute issues a list of the contributions made to scientific literature and of patents taken out during 1925. This list is of formidable length, but what strikes one most is the exceedingly practical nature of the majority of the investigations pursued and their great diversity. Problems relating to coal, coke, and petroleum are, perhaps, most conspicuous, but there is also a goodly array of contributions relating to metallurgy, refractories, laundering, and foodstuffs.

DR. WEIDLEIN has also written an essay entitled "The Administration of Industrial Research" (*Industrial and Engineering Chemistry*, January 1926), in which he discusses the various factors that make for success in the conduct of a research organisation, such as the selection of research workers, organisation, co-ordination of effort, and the virtues of team work. The principles involved in the management of a research laboratory are set out on the lines of Taylor's "Principles of Scientific Management," and "the functions of laboratory organisation" are analysed in detail. The essay may be recommended for perusal by directors of research; it will interest them, although they may not find it entirely convincing. Many of the 'principles' and 'functions' enumerated appear to be obvious, not to say platitudinous, and one is left with the impression that an organisation in which every entity and activity, physical, moral and intellectual, is dissected, described, catalogued, charted and labelled, is scarcely the place where the free spirit of scientific adventure can dwell with patience or good will.

DR. WEIDLEIN is undoubtedly on strong ground when he pleads for a proper business foundation for every institution devoted to industrial research, but we foresee trouble if, as he advises, the activities of a research department are "adjusted constantly to suit the needs of the concern," or if the research worker becomes too intent on "keeping in line with psychological laws." Some of the author's *obiter dicta* are also open to question. We can, for example, hear

Candide and the initiators of gas-warfare chuckle when they read: "If a scientist is productive in his investigations, his work must result for the good of humanity"; and we do not think that Schiller, who wrote that "talent is formed in quietude, character in the current of the world," would have agreed with the assertion that "The character of virtue is best seen in the life of a scientist devoted to the service of research."

ON Thursday last, July 1, unfortunately too late for insertion in our issue of July 3, we received the following telegram from Prof. W. H. Keesom, of the University of Leyden: "Helium solidified under a pressure of 150 atmospheres at the temperature of its boiling-point and under 28 atmospheres at 1·5° Abs. Solid helium forms transparent mass." This achievement thus rounds off the work of the late Prof. H. Kamerlingh Onnes, begun more than thirty years ago. By his extraordinary energy and organising ability Kamerlingh Onnes built up his cryogenic laboratory in Leyden, and in 1904 was able to obtain supplies of liquid air. By 1906 he was liquefying hydrogen on a large scale, and in 1908 he succeeded in liquefying helium. This enabled him to obtain a temperature of 4·22° Abs., and by reducing the pressure the temperature was further reduced to 0·9° Abs. Attempts were made with the pressure so low as 0·2 mm. to solidify helium but without success, and it has remained for Prof. Keesom, apparently using an increased pressure method, to complete the work which 'the master' left unfinished.

To all interested in navigation the problem of the issuing of suitable signals at danger spots in the ocean or near the coast is of the greatest interest. There are many spots where it is too expensive to provide a keeper to attend to the light and fog signals, where also, on account of the rocky bottom, strong tides, and ships' anchors, it is impracticable to maintain a submarine cable connexion. It is interesting to hear, therefore, that the Marconi Company has established an unattended fog-signal station on Rosneath Beacon on the Firth of Clyde. It was installed last January and its working has proved very satisfactory. The control is by radio waves, and we see no reason why the same method should not be applied to control other kinds of mechanical apparatus acting at a distance. Rosneath Patch is a sandbank in mid-channel at the mouth of the Clyde between Gourock and the opposite Argyllshire coast. A reinforced concrete beacon marks the Patch. Automatic apparatus has now been installed which gives signals by exploding a mixture of air and acetylene gas. Once started, the 'guns' continue giving explosions until they are switched off or until the acetylene gas is exhausted. These guns are the only automatic signals at present in use, being cheap to install and maintain. At Rosneath Beacon they get their supply of acetylene gas from a carbide-to-water plant. A radio receiving apparatus is fitted and is synchronised with the transmitting set on Gourock Pier, 1¼ miles from the Beacon. When fog is observed, the transmitting apparatus is put into operation and the radio impulses act on the receiving apparatus. The signals being periodic prevent atmospherics acting on the receiving set. When the fog clears, another set of periodic impulses having a different period is transmitted and stops the signals. The annoyance to the neighbourhood is thus reduced to a minimum. The essential features of the sending apparatus are a pendulum and mercury break, a spark coil and a quenched spark transmitter.

THE Cretan earthquake on June 26 has been followed by others in various parts of the world, on June 28 in Sumatra and Rhineland, on June 29 in southern California and at Salisbury in southern Rhodesia, and on June 30 by another in Sumatra. In a letter published in the *Times* of June 30, Prof. Turner places the epicentre of the Cretan earthquake in 35° 0′ N. lat., 24° 0′ E. long., or just south of Crete, the same spot having been the seat of seven smaller earthquakes between 1913 and 1922. The damage at Candia and in some of the surrounding villages was considerable, including injury to many of the remains from Knossos collected in the Candia museum. A telegram from Rome, dated June 28 states that more than two thousand houses have been destroyed by earthquake-shocks in several villages in the province of Foggia in southern Italy, but these shocks can scarcely be connected with the Cretan earthquake, even if they occurred on the same day. The earthquake in Rhineland at 11 P.M. on June 28 was evidently felt over a wide area, at Cologne, Freiburg and other places in Germany, at Basel and Bern in Switzerland, and at Strasbourg, Epinal and Belfort in France. Though few details are as yet known of the Sumatra earthquake of June 28, it was clearly one of great strength, for many villages have been destroyed, and the railway and main roads near Padang have been much damaged. One of the most interesting of the recent earthquakes was that in southern California on June 29. At Santa Barbara it was strong enough to cause some very slight damage. It was probably an after-shock of the destructive earthquake in the same district on June 29, 1925 (NATURE, 1925, July 11, p. 56, and August 29, p. 324).

THE Royal Air Force display, such as was seen at Hendon on July 3, is more spectacular than the old *Kaisermanöver* and more exacting than Fleet exercises, and sums up from year to year the visible progress in design, operation, and discipline. A hundred and thirty aeroplanes in the air during the day, with half-a-dozen out of action from minor causes, is a remarkable achievement of design and maintenance. Types ranged from the 700 h.p. single-seat fighter, with corresponding speed and climb, to the eight-ton twin-engine bomber (900 h.p.), and the three-engine 20-seat commercial aeroplane (1000 h.p.). 'Acrobatics' by individual pilots, squadron drill with nine aeroplanes, orders being given by radio telephony, and group drill with six squadrons, stirred the layman to loud applause and the expert to deep appreciation. The Hill tailless aeroplane and the first British-built Cierva autogyro might be considered as outward signs of the work of the Director of Research, which

also lies less directly and visibly behind all manner of detail advances in standard equipment. From this pageant and from day to day work we may judge soberly that the British Air Service is holding its own in a keenly competitive world.

SIR FLINDERS PETRIE, in a letter to the *Times* of July 2, reports on the work of the British School of Archæology in Egypt during the past season. The investigations of Mr. R. S. Sandford on the history of the Nile during the pluvial period, carried out in the region between Thebes and Sohag, have linked the gravels carried down from the eastern granite mountains with palæolithic man. Starting from a gravel terrace at 150 ft., the 100-ft. terrace was laid down during the Chellean and early Acheulean period, the 50-ft. terrace in Acheulean times, while the latest gravel terrace at 10 ft. above river level contains Mousterian implements. Miss Thompson, continuing her work in the Fayum, has found, in addition to crude pottery and a large number of flint arrow heads and knives, a new feature in the form of granaries situated at a higher level. These are about 3 ft. across and sunk in the gravel. They are lined with coiled straw rope. The grain was mostly emmer and barley, but also included true wheat. Investigation of the tumuli on the island of Bahrein in the Persian Gulf by Mr Mackay produced scanty results, but a bronze spearhead indicates a date of 1200–1500 B.C., which is supported by the character of the pottery. The forms of the pottery include Mesopotamian types, but the greater part is entirely independent. The work on the back of an ivory statuette is like nothing known elsewhere.

THE weather for the second quarter of the year, April-June, was generally wet, cool, and dull in the British Isles. Warm and bright weather at this season is so essential for vegetation that a few facts gathered from the Greenwich weather observations, which represent the south-east of England, may help to show the absence of fair conditions. The rainfall was in excess of the average in each month, yielding an excess of 3·66 in. for the three months ending June. April was mild, but the latter part of the month was colder than the early part; April 25 and 26 had maximum day temperatures below 50°, and for seven days from April 20-26 the maximum day temperature was below 54°, the normal maximum for the month being 57°. May was unusually cold for the first 20 days, and during this period the maximum temperature was only above 60° on 4 days; the highest day temperature was 63°. Warmer weather set in after the third week, which brought the mean temperature for the month to 52°·5, which is only 1°·5 below the normal. In June only 8 days at Greenwich were above the average, and 22 days were below the average temperature. The absence of bright sunshine was evidently the cause of the continued cool weather. April had sunshine for 101 hours, which is 3·37 hours a day, or 1·65 hours a day less than the normal; there were only 11 days with more than 5 hours' sunshine, and in all, only 6·4 hours' sunshine in the last 11 days of April. May had 149 hours' sunshine, which is 4·81 hours a day, or 1·66 hours a day less than the normal. In June the total sunshine was 180 hours, or 5·99 hours a day, which is 0·71 hours a day less than the normal.

THE evolution controversy in the United States still sends echoes across the Atlantic. The *Forum*, an American periodical for an intelligent but non-specialising public, has in its June issue a reply by Prof. H. Fairfield Obsorn to an article attacking the "Fancies of the Evolutionists," by John Roach Straton, which appeared in February last. Prof. Osborn sets out to demonstrate "certain irrefutable facts" constituting the evidence for the geologic antiquity and creative evolution of man. The article is both a summary of present knowledge relating to the origin, evolution, and distribution of mankind, and a history of discovery in this province of research, necessarily in both cases brief and in outline only. The accusation of a conspiracy among evolutionists is met by a statement of the fact that in the case of crucial discoveries, such as that of the Trinil skull or Neanderthal man, the interpretation which assigned them the place in the human evolutionary series which they now hold was not immediately and universally accepted by scientific men. Further, Prof Osborn points out that the experience of a hundred and fifty years, or on some matters of centuries, has brought the methods of scientific research in this field to such a point that the evidence can be interpreted with certainty and precision. The data are not "blurred or indecipherable documents like the palimpsests of many sacred writings, but are absolutely unchallengeable records as clear as daylight to the man who has learned how to read them" —a statement to which Prof. Osborn's own article may perhaps suggest some slight reservation. The existence of a fact is indisputable, but what of its interpretation? Prof. Osborn himself did not at one time accept the human attribution of the Piltdown jaw. However, his position is sound, and the main argument is not to be shaken by a minor inconsistency.

MR. HERBERT KRIEGER, of the United States Museum, while on his way to south-eastern Alaska, where he will carry on the work of restoration of the totem poles of that area, has made a survey of the pit-house sites of the old Yakima and Klickitat Indians of the Columbia River region of the State of Washington. This area would appear to have supported one of the densest populations in early America. Mr. Krieger reports the existence of a chain of house-sites stretching for 500 miles along the banks of the Columbia from the Dalles in Oregon to the Canadian border. The river was undoubtedly one of the great trading centres and routes of travel. Eight skeletons and forty-five artefacts were obtained by excavation in a burial ground. The artefacts showed no sign of Hudson Bay Company influence. The skulls exhibited cradle-board deformation similar to that of neighbouring tribes of to-day. Pictographs cut in the basalt cliffs of the river bank showed shields, bows, arrows, goats, big-horn sheep, and

designs suggestive of the rising sun, lightning, and so on. It is perhaps worth mention that Mr. Harlan I. Smith has recently recorded pictographs, which these would appear to resemble, found in a similar position in British Columbia.

THE *Times* of June 29 contains an interesting account of the recent Hokkaido eruption written by its Tokyo correspondent. Like some other Japanese volcanoes, Tokachi has two peaks. One of them has a fairly well-defined crater with its north-east wall denuded or blown away. The other, known as Iwo-dake or sulphur mountain, had a small crater occupied by a lake. On May 7 the mountain, supposed to be extinct, showed some signs of activity: slight rumblings were heard and a small column of steam was emitted. On May 23 the rumblings, which had continued, became more pronounced, and on the following day the crater of Iwo-dake was breached by the rising lava-column, a large portion of the crater-wall fell down the mountain-side, and the water of the lake was released. The resulting destruction and loss of life were caused chiefly by the avalanche of mud, which swept over an area ten miles long with a maximum width of four miles. Its force is shown by the fact that at Kami Furano a mile and a half of the railway line was torn away and twisted like wire. When the water subsided, an area of ten square miles of highly cultivated rice land was left covered by a layer of sandy mud with an average thickness of 18 inches.

WE must all deplore the disappearance of examples of English architecture dating from the Middle Ages and later which is rapidly taking place in our villages owing to economic and social development. The awakening of public interest in this matter is tardy and spreads but slowly among those in whose hands control is vested. Sir Frank Baines's lecture on "The Preservation of Ancient Cottages," delivered before the Royal Society of Arts on May 6 last and now published in that Society's journal, is opportune, and should be made widely known. As he points out, the ancient workman's cottage is not merely a thing of considerable beauty; it is almost the sole piece of tangible evidence we possess of the social and economic position and of the material conditions of life among the peasant population from the Middle Ages up to the seventeenth and early eighteenth centuries The lecture, as published, is illustrated by photographs of a large number of examples of this class of domestic architecture. Of these, the number which have now disappeared, among them some of the most beautiful and characteristic, is in itself an eloquent argument for the urgent necessity of early action.

DR. F. A. BATHER, president of the Geological Society, will unveil a mural tablet to William Smith on July 10 at 29 Pulteney Street, Bath. After the unveiling ceremony, there will be a luncheon at the Guildhall, to be followed, in the afternoon, by an address by Dr. Bather at the Royal Literary Institution on William Smith and his work.

SIR ERNEST RUTHERFORD (Cambridge), Sir Frederick Hopkins (Cambridge), Prof. H. A. Lorentz (Haarlem), and Dr. H. L. le Chatelier (Paris), were elected foreign members of the Académie Polonaise des Sciences, Cracow, last year. In conformity with the statutes of the Academy, such elections have to receive the sanction of the president of the Republic of Poland. We are glad to know that this has now been given, and that the elections can be announced.

SIR JAGADIS C. BOSE, founder and director of the Bose Research Institute, Calcutta, who is at present in England lecturing and giving experimental demonstrations on plant stimuli and responses, has been elected president of the Indian Science Congress to be held in Lahore in January next.

ROYALTY has always been credited with the parentage of anecdote, but we hope that this one is genuine. A charming young American, having met the Prince of Wales at a reception, asked him to tell her how he ought to be addressed, as, for example, on an envelope. The Prince—says the story—took her programme and wrote upon it: "To His Royal Highness, The Prince of Wales, K.G., F.R.S."

UNDER the title of "Illumination Research," the Department of Scientific and Industrial Research has issued a pamphlet, which will be supplied gratis on request, in which the work of the Illuminating Research Committee appointed in July 1923 is described. At the present time the following problems are under investigation: The transmission of light by window glass, the effect of the colour of the walls of a room on the light in the room, the use of prismatic glass in the windows, the lighting of picture galleries, the effects of enamel reflectors as used in works, the effect of glare on the eye and the influence of the amount of light on the ease and accuracy with which fine work can be done. The pamphlet does not deal with finance, but there are few who would care to challenge the expenditure of a few thousand pounds in this way in order to determine how best to get value for the millions of pounds spent annually in Great Britain on illumination.

WE have received the "Classified List of Publications of the Carnegie Institution of Washington" dated December 1925. This, with its detailed abstracts, is itself a publication of some value; but it does not appear to indicate clearly those works that have been issued since the distribution of the previous list.

WE have recently received volume 3, for 1924, of the *Publications biologiques de l'École des hautes Études vétérinaires*, Brno. Ten contributions are contained therein; in the index they are paged consecutively, but in the text, pagination commences afresh with each paper, a much less convenient arrangement. Botanical problems of development are dealt with, by Staroštík, on the bud of *Ficaria verna* and the influence of external agents on its growth, by Pavlů on the histology of the beet, and by Václavík on correlation between cotyledon and axillary bud in the pea. The other seven papers are zoological or physiological, again with emphasis on the experimental study of development.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in experimental physiology in the University of Manchester—The Internal Registrar (July 14). A junior lecturer in mechanical and electrical engineering and a junior lecturer in geography at University College, Nottingham—The Registrar (July 17). An organiser of mining instruction for Derbyshire—Director of Education, County Education Office, S. Mary's Gate, Derby (July 17). A research chemist for work on plasters and other materials used for impressions and models in dentistry—Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (July 21). An assistant at the Commonwealth of Australia Observatory at Mount Stromlo—The High Commissioner for Australia, Australia House, Strand, W.C.2 (July 22). A temporary assistant chemist at the Naval Ordnance Inspection Depôt, Holton Heath—Secretary of the Admiralty (C.E Branch), Admiralty, Whitehall, S.W.1 (July 24). An assistant lecturer in pure mathematics at the University College of Wales, Aberystwyth—The Secretary (July 28). Temporary assistant chemists in the Government Laboratory—The Government Chemist, Clement's Inn Passage, Strand, W.C.2 (July 31). An additional zoologist for the *Discovery* Expedition—The Secretary, *Discovery* Committee, Colonial Office, Downing Street, S.W.1 (July 31). A junior technical officer for the wireless experimental department of the Royal Aircraft Establishment—Superintendent, R.A.E., South Farnborough, Hants (July 31, quoting A.79). A botanist for the agricultural department of the Government of Nigeria—Private Secretary (Appointments), Colonial Office, 38 Old Queen Street, Westminster, S.W.1 (August 15). A director of the Veterinary Laboratory of the Ministry of Agriculture and Fisheries at New Haw, Weybridge—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (November 1). A director of research under the Research Association of British Paint, Colour and Varnish Manufacturers—Mr. J. B. Graham, 8 St. Martin's Place, W.C.2. A man with teaching experience in physics, chemistry and mechanics—Cordwainers' Technical College, St. John's Lane, E.C.1. An assistant at the Darlington Technical College, chiefly for geometrical and engineering drawing, and either engineering science or mathematics—Chief Education Officer, Education Office, Darlington. An advisory agricultural economist at the Midland Agricultural and Dairy College, Sutton Bonington, Loughborough—The Principal.

Our Astronomical Column.

LARGE SUNSPOTS.—The naked-eye sunspot recently noted in these columns was followed shortly afterwards by the appearance of another which was seen as a naked-eye object from June 26 until July 1. In a small telescope, the spot appeared elongated with a double umbra, there were several small companions near it and others in a cluster following at some distance. Details of position, etc., are given below in the usual tabular form. This latest spot brings the total number of naked-eye spots to eight for the first six months of 1926, as compared with eight for the whole of the preceding year.

No.	Date on Disc.	Central Meridian Passage	Latitude	Longitude	Area.
8	June 23–July 5	June 29·2	21° N.	140°	1/1250

(Area expresses the proportion covered of the sun's hemisphere.)

PONS-WINNECKE COMET AND METEORS.—Mr. W. F. Denning writes: "Announcements emanating from Russia have been published to the effect that a meteoric shower might occur between June 24 and July 1. The fact that the parent cause, Pons-Winnecke's comet, would be situated at a distant point of its orbit, which it occupies twelve months before perihelion, robbed the prediction of any weight that it might otherwise possess. It is true that in 1916 there was a meteoric shower ten months after the comet had passed its perihelion, but there were great doubts as to whether the cometary materials were abundant at a spot so remote in front of it. The result of observation was anticipated, for though June 24-30 proved fairly clear, few meteors could be seen in the brilliantly moon-lit skies of the period.

Meteoric observers will anticipate a shower next year with more confidence and with conditions which appear to be favourable. Even in 1928 there may be many meteors seen, judging from the experiences of 1916, which showed that they were distributed far behind the comets. Probably also the stream is spreading out with time, and that even if the ellipse is not at present continuous it will ultimately assume that form.

The brightest meteor lately seen was on June 27, $23^h\ 20^m$ G.M.T. The meteor was moderately slow and about equal to Jupiter: duration, 2 sec. The probable radiant was in Sagitta and far from that of the Pons-Winnecke comet. The meteor was also observed by several other persons in Bristol, and they mention it as giving a distinct flash like summer lightning."

NOVÆ.—The *Observatory* for June contains a detailed summary of the paper read by Dr. J. Lunt on Nova Pictoris at the May meeting of the Royal Astronomical Society. The radial velocity indicated by the dark lines gradually increased, being (in km./sec.) −71 in 1925 May, −81 in early June, −92 in late June, 320 July to August, −395 in mid-September, −411 in January, −436 in March. Bands resembling those in η Argus began to appear in October, and gradually became more evident. The nebular bands customary in the later stages of novæ did not appear until March. Dr Lunt endorses the words of Prof. Hartmann's telegram to *Astr. Nachr.*, "The star swells up and bursts." He considers that the star was discovered at the simmering preparatory stage, and that the explosive ebullition came later. The cause is conjectured to be a release of atomic energy within the star.

F. Pingsdorf of Parana (Argentine) gives a series of measures of brightness of the nova. The following summary gives the magnitude at the beginning of each month: December $4·2^m$, January $4·3^m$, February $4·6^m$, March $5·1^m$, April $5·4^m$, May $5·5^m$. The star thus remained an easy naked-eye object for a year, which is longer than most recent novæ, though less than Tycho's famous star.

Beobacht. Zirk. No. 23 contains a note by Prof. M. Wolf on his faint nova in the spiral nebula N.G.C. 4303 (Messier 61). He obtained two photographs on June 1 that show a marked diminution of light since discovery on May 12. Its magnitude was then about 14^m, and 15^m on June 1; on the latter date it was $0·2^m$ fainter than the star south preceding the nucleus at a distance of 1·3′. This rapid decline makes the American estimate of the star's total light as being 10 million times that of the sun appear somewhat doubtful.

Research Items.

DEPOPULATION AND DISEASE IN THE NEW HEBRIDES.—Dr. P. A. Buxton, of the London School of Hygiene and Tropical Medicine Expedition to the South Pacific, in a communication to the Royal Society of Tropical Medicine and Hygiene, which is published in vol. 10, No. 8, of the *Transactions* of that Society, discusses the question of depopulation in the New Hebrides and examines the evidence bearing on the statement generally made as to the extent to which this is due to diseases introduced by Europeans. Depopulation appears to be going on rapidly on all the islands except Tanna, Aniwa, and the north part of Pentecost. On Tanna, Tonga, Tongariki, and Buninga, numbers are stationary or rising, and on Futuna and Aneityum they may have reached their lowest and begun to rise. A calculation based on figures going back as far as any records are available for the five islands Aneityum, Aniwa, Futuna, Erromanga, and Epi, shows that there is no consistent rise or fall throughout the period, which in one case goes so far back as 1865. This seems to imply that the principal causes of depopulation were as active in the last century as now. To some extent the decline may be due to native customs—the institution of gerontocracy, which reserved marriageable females to the old males, abortion, a practice which repression of polygamy tends to increase, wars, belief in magic, bad housing, and unsuitable feeding of infants. The evidence of pedigrees shows an actual decrease in the birth-rate. The recruitments of native labour carried off the younger men as well as introduced disease. Of diseases, the most serious are malaria and yaws, but dysentery and pulmonary diseases play an important part. Two disquieting facts are that the rate of decline is no less now than it was fifty years ago, notwithstanding the abolition of 'blackbirding' and the reduction in the severity of epidemics, and that about 118 males are born per hundred females, this disproportion persisting through life. These facts almost warrant the prediction of the eventual extinction of many of the races now living in the New Hebrides.

THE ARTIFICIAL PRODUCTION OF LUSTRE ON FLINT IMPLEMENTS.—Mr. W. J. Lewis Abbott, 8 Grand Parade, St. Leonards-on-Sea, writes to say that he has discovered a process which simulates the somatic change in flint implements responsible for the production of the high glaze usually accepted by archæologists as a criterion of age. He points out the inapplicability of the term 'patina'—in origin a term used to describe the surface lustre of bronze—to all the various types of metamorphosis to which flint is subject. These metamorphoses are either superficial or somatic. The high glaze which arises from the superficial metamorphosis is due to attrition and can be produced artificially by sand-blast or running water charged with sand. The somatic metamorphosis in Nature is practically confined to the vitreous variety of flint, although it sometimes occurs in the normal and very rarely in the cryptogranular. In mixed flint it will appear in the vitreous and stop at the cryptogranular. The black, almost opaque flint becomes like a slightly clouded, otherwise colourless, clear hyalite, more brilliant and transparent than 'Hungarian' opal, taking the most brilliant colours in the presence of various salts of iron. The metamorphosis takes place below the surface and works towards it until the conversion is complete, or it may occur in excessively small islands. The specimen may retain its elasticity, but if this is lost, it is obvious that the implements were made before the alteration set in. This form of metamorphosis has now been produced artificially. Flint—vitreous, normo-vitreous and normal—fashioned into implements by Mr. Abbott himself, has been submitted to a certain process which has entirely opalised it, with the result that the nearly opaque flint is now translucent, of various shades of brown, and has a most brilliant glaze. Specimens have been submitted to Sir Arthur Keith, who states that he has "never seen a richer or finer patina," and characterises Mr. Abbott's discovery as "very clever and dangerous."

FISH STOCKING IN AMERICA.—Mr. C. W. Creaser has recorded the results of successful attempts at stocking the upper waters of the Great Lakes with smelt, *Osmerus mordax* (*Michigan Academy of Science, Arts and Letters*, vol. 5, 1925). All the eggs used in the various stocking operations were from Green Lake, Maine; the smelt, which is a native of this lake, belongs to a freshwater race of the marine species common along the North Atlantic coast. Evidence is produced to show that transplantation of eggs, which was first started in 1906 and was continued in different years up to 1921, has led to firm establishment of the species, and that in some localities natural spawning has been going on for several years. Mr Creaser gives an interesting account of the spawning of this fish in Crystal Lake, Michigan; this takes place very early in the spring (April), before the ice breaks up in the lake as a whole. The fish move in a body into small streams; the main run is at night, most fish returning to the lake in the daylight. A vivid description is given of the solid masses of fish assembling to spawn. The fish were extremely susceptible to light, which they avoided; so strong was this reaction that the entrance of fish into the stream could be regulated by a flash-light. A reaction to currents was also exhibited. A note on the feeding habits of the smelt elicits the fortunate fact that the adults feed in the summer almost entirely on a species of minnow on which other fish do not feed, and that hence they cannot be regarded as serious competitors for food. Details of age determination by scale reading are given; the smelt first breeds at the end of its second winter.

BOT FLIES OF THE PUNJAB.—*Bulletin* 160, *Agricultural Research Institute*, Pusa, 1926, is devoted to an account of certain of the bot flies prevalent in the Punjab and is written by Captain H. E. Cross. A very common species, forming warbles in goats, is *Hypoderma crossii*, which infects 40-90 per cent. of those animals in the Salt Range area. The larvæ, pupa and adult of this species are described and figured, but the eggs have so far remained undiscovered. The ox warble, *Hypoderma lineatum*, and its occurrence in the Punjab is noted, and this appears to be the first record of its being found in India. The camel bot fly, *Cephalopsis titillator*, is widely distributed throughout the Punjab and various stages in its life-cycle are figured and described. This insect is viviparous and the first stage larvæ occur in the nostrils of the camel. When about 7 mm. long until fully grown they are met with in the pharynx and are finally expelled through the nostrils, pupation taking place in the soil a few hours later. So far as known, the species does not entail much injury to its host, but it is possible that it may cause *kapauli* (pus in the sinuses), which is a fatal disease. Among other species the common sheep bot, *Oestrus ovis*, the wild sheep bot, *Oestrus*, sp. nov. ?, the horse bot, *Gasterophilus equi*, are also dealt with. The bulletin concludes with a brief discussion of the injuries caused by these flies and of the methods of treatment.

THE SWAMP CYPRESSES.—The swamp cypresses, and particularly Glyptostrobus, are not well known in Great Britain, so that the taxonomic and anatomical notes by Prof. Augustine Henry and Marion McIntyre in the *Proceedings of the Royal Irish Academy* (vol. 37, B. 13, 1926) will serve a useful purpose. Glyptostrobus, the water-pine of the Chinese, they conclude, is a monotypic genus; this species being found only in two swampy localities in south-eastern China. The Chinese regard the presence of the tree as propitious to the rice crop, and the villagers resist its molestation, even by the photographer. *Glyptostrobus pensilis* is also one of the rarest cultivated trees in Europe, only one specimen growing in the open being known to the authors (at Nymans, Sussex). There are living plants under glass at Kew and Glasnevin. The three living forms of the much better known swamp cypress of America, Taxodium, are also passed in review as to macroscopic and microscopic characters of branchlets, leaves, flowers and cones, in order to permit a comparison with Glyptostrobus. In view of the necessity, often present to the palæobotanist, of distinguishing between genera on structural features alone, a comparative study of the wood of these two genera and also of Wellingtonia and Sequoia is included in the paper.

BIOCHEMICAL DIFFERENCES BETWEEN THE SEXES OF MUCORS.—In the Mucors, Blakeslee, in particular, has shown that in many species two sexual strains may be distinguished; individual mycelia of the same sex will not conjugate, whilst conjugation occurs freely between mycelia of different sex. These 'heterothallic' strains thus occur in sexual pairs, but the form and structure of one sex is practically identical with that of the other, and, apart from the behaviour on conjugation, the two sexes cannot be distinguished, except, perhaps, by a difference in vigour of growth. Blakeslee has provisionally designated these as (+) and (-) strains, the plus strain being the more vigorous when this growth distinction can be drawn. Sophia Satina and Blakeslee now report (*Proc. Nat. Acad Sci.*, Washington, March 1926), in a preliminary manner, upon a biochemical study of these Mucor sex strains. They conclude that the (+) and (-) races show significant, average, biochemical differences in respect to (*a*) the Manoilov reaction, (*b*) catalase content, (*c*) reduction of potassium permanganate by extracts of the mycelium, and (*d*) reduction of tellurium salts in living cells In a subsequent paper they apply biochemical tests to unisexual flowering plants, obtaining additional evidence in support of the conclusion that the female plant and the (+) strain of a Mucor show similar biochemical behaviour. A certain statistical element enters into this type of observation. As the authors put it, the general rule that the human male is the heavier is not vitiated by the fact that on chance selection of a human pair an especially buxom female might be put in contrast with a meagre male.

AGRICULTURE IN ARID LANDS.—In a paper on the struggle with arid conditions in the Volga region (*Matériaux pour l'étude des calamités*, No. 8, January-March 1926) Mr. N. M. Toulaikoff, who is director of the experimental station at Saratoff, makes several constructive suggestions for safeguarding agriculture against the arid conditions in the Volga region. An average rainfall of about 16 inches is small enough considering the summer heat, but it is not the slight total amount that natters so much as its irregularity in fall. While poor crops and want occur generally in years of deficient total rainfall, there have been instances of abundant crops in years of scanty rainfall. In those years the rain fell in the seasons demanded by the crop. The main crop of the peasants has always been summer wheat, which suffers severely from spring drought and cannot recover when the rains come so late as June and July. More satisfactory crops would be rye, which develops before the most usual period of drought, and maize, millet, sorgho, and beet, which develop in June and July and do not suffer from the prolonged heat of summer. A study of these problems has been made on experimental farms, and it is considered that the likelihood of famine could be minimised if not banished by adapting agriculture to the peculiarities of the climate.

GEOLOGY OF THE WEALD.—Among regional surveys now being carried out may be mentioned the work of the Weald Research Committee of the Geologists' Association. This consists of a geological survey on the 'six-inch' scale of the Weald, which is being actively pursued by the members of the Committee, who number about two dozen, each member having undertaken to survey the country comprised in at least one 'six-inch' sheet. It is just over fifty years since the survey by W. Topley was published by the Geological Survey, but while our knowledge has been extended locally, no general geological survey has been attempted previous to the initiation of this committee. No point of geological interest is being neglected; the petrology as well as the palæontology of the beds is being worked out in detail, while a good start has been made in the complex problems involved in the denudation of the area. This branch of the work will occupy a considerable time, but some points of interest are already being elucidated; for example, a late Pliocene terrace discovered in the Mole gap has produced widespread planation in the district especially north of Ashford. The Committee has very properly not set itself any definition of the Weald, for its researches must extend well beyond the region to which the name applied originally. In this connexion the gravels of Rayleigh in Essex may be cited. These contain pebbles of Lower Greensand chert, which may have been derived from the Weald through the Medway gap, and if this proves to be the case the pebbles travelled across what is now the lower Thames.

THE TRAVEL OF DEPRESSIONS.—The *Meteorological Magazine* for April gives an interesting and descriptive account by Lieut.-Col. E. Gold, assistant director of the Meteorological Office, on the foregoing subject. The article should prove most instructive to meteorologists not well versed in the new ideas relative to cyclones which are proving of immense value to the weather forecaster, either official or otherwise. From the initiation of forecasting, cyclonic depressions have necessarily proved almost the controlling feature. The movement of cyclones in the British Islands and their vicinity differs so widely, and the area controlled or affected varies so considerably, that it seems almost impossible to forecast effectively. The development by Bjerknes of the idea of cold and warm sectors in the individual cyclones separated by definite surfaces of discontinuity has enabled the Bergen school to divide cyclones into different classes according to their stage of development. They draw a distinction between (*a*) cyclones which have a definite warm sector with definite lines of separation from the cold sector, and (*b*) cyclones in which there is no warm sector at the surface of the earth. Class (*a*) are generally growing cyclones which usually move with increasing speed as they grow, and Class (*b*) are dying cyclones which tend to become stationary. In Class (*a*) the centres of the cyclones move in the direction of motion of the air in the warm sector, and approximately with

the speed of motion of the warm air; a diagrammatic representation is given of such a cyclone. A description is also given of Class (*b*), in which there is no warm sector. Cyclones of Class (*a*) eventually lose their warm sector and change into Class (*b*); the warm sector only disappears at the earth's surface, the warm air being lifted up by the colder air, and the discontinuity will continue to exist at greater heights. The author alludes to the difficulty of giving in so short an article anything like a complete account of the technical investigations, but his mastery of the subject has suggested much which is helpful to the less initiated.

ELECTRON EMISSION ENERGY WITH OXIDE CATHODES.—In the *Zeitschrift für Physik* of April 30, Herr H. Rothe describes a series of measurements on a number of triode valves with oxide cathodes in which the energy of emission of the electrons was determined, using Richardson's equation, and also by means of the cooling effect produced by the emission. The values found by the two methods, which agreed quite well with one another when the emission current was saturated, were exceedingly small. The relation between the emission from such cathodes and the amount of gas removed from them was investigated. It seems that it is not possible to free oxide cathodes from gas perfectly; apparently the emission current which passes through the oxide layer radially decomposes the oxide and so constantly produces new gas. The author considers that the high emission of these cathodes depends on the metal particles, produced by this decomposition, which remain embedded in the oxide. It is noted that if the emission current is below the saturation value the cooling effect is considerably greater than that corresponding to the energy of emission. A fatigue phenomenon has been investigated, which in almost all the tubes caused the emission current to fall off rapidly with the time.

THE PALLADIUM-HYDROGEN EQUILIBRIUM.—The absorption of hydrogen by palladium has been the subject of much experimental study since it was first reported by Graham, and the results of the latest investigation by L. G. Gillespie and F. P. Hall appear in the *Journal of the American Chemical Society* for May 1926. They describe a method of securing equilibrium by means of a new heat treatment, and the isotherms which they determined indicate the presence of two solid solutions At the higher temperatures the solution richer in hydrogen is said to consist of a hydride Pd_4H_2

SILVER IODIDE IN GELATIN IODO-BROMIDE EMULSIONS.—R. B. Wilsey has recently found, in studying the crystal structure of mixed crystals of silver iodide and bromide, that the cubic lattice characteristic of silver bromide has some of its bromine replaced by iodine with an enlarged lattice spacing when it is crystallised with silver iodide. But when the iodide is present to the extent of about 40 per cent. or more, there was a second lattice spacing corresponding to that of silver iodide. Emery Huse and C. E. Meulendyke of the Kodak Research Laboratory (*Journal of the Royal Photographic Society*, June, p. 306), have sought to fix the proportion of silver iodide present when it begins to form separate crystals from a mixture of the two salts. A series of gelatin emulsions was prepared containing increasing quantities of iodide, and exposures in a spectrograph were developed physically, as silver iodide is scarcely amenable to alkaline development. The physical development of silver iodide gives a very sharp-edged sensitivity limit at wave-length 440 mm., and as the iodide was increased this first appeared when the iodide constituted 32 per cent. of the mixed haloids, and remained as the iodide was increased, and was entirely lacking at 30 per cent. or less. The authors therefore conclude that silver iodide separates in emulsions of this type as definite crystals, apart from the silver bromide, when the silver iodide content reaches approximately 32 per cent.

HELIUM IN NATURAL GASES OF JAPAN.—The thirteenth report of the Aeronautical Research Institute, Tokyo Imperial University, published early this year, contains an account of an examination of natural gases from Taiwan, Hokkaido, Honsyu and Kyusu, primarily for helium, by Messrs. Y. Kano and B. Yamaguti. The gas samples were taken from various sources, such as oil reservoirs, coal-mines, mineral springs and volcanoes, and were analysed for helium by Cady and McFarland's method, for other constituents by Hempel's standard method The purity of the helium was tested spectroscopically. Carbon dioxide, sulphuretted hydrogen, oxygen, carbon monoxide, methane, ethane, nitrogen and heavy hydrocarbons were among the chief constituents of the gases investigated, and from the analytical results it has been possible to classify the natural gases into three types rich in carbon dioxide, in hydrocarbons and in nitrogen respectively; as in the case of helium in American natural gas, the percentage of this element is highest in nitrogen-bearing gas. The helium content of some mineral spring gases examined reaches 0·2-0·3 per cent., but unfortunately the amount of gas available from this source is strictly limited and insufficient for industrial purposes; very small quantities of helium were found in the gas from the Taiwan and Hokkaido areas, where it is associated with petroleum, the average being 0·005 per cent, again an impracticable amount for commercial purposes. The oil and gas reservoirs of Taiwan and Hokkaido are of Tertiary age, from which the low helium content of the gas from these sources is accordingly explained The authors find that the percentage of helium in a hot spring gas depends to a certain extent on emanation content, though no direct ratio could be established, this agreeing with McLennan's conclusions with regard to Canadian natural gas. Samples containing no helium generally possess the least radioactivity, and this to some extent supports the theory that the origin of helium in natural gas is to be ascribed to disintegration of radioactive substances; if this is so, then it is clear that the geological age of a gas reservoir is an important criterion of helium possibilities.

SIZES OF AERODROMES.—It is a matter of some considerable importance to determine the size of aerodrome necessary in order that a landing may be made on it if engine failure occurred at any time during getting off. In an interesting paper by H. Glauert to the Aeronautical Research Committee (R. and M. 996, pp. 10. London: H.M. Stationery Office, 1926, price 6*d*.), this question is investigated more especially in the two cases: (1) where the aeroplane continues in its original direction after the engine failure; and (2), where the aeroplane, climbing on a steady turn, on failure swings back into the wind. A comparison of the results of these two cases shows that an important saving in the necessary size of the aerodrome can be secured by the turning climb, but the size of aerodrome indicated is larger than that of current practice unless the stalling speed and power loading are limited. Curves are given showing the necessary size of aerodrome in terms of stalling speed and power loading of the aeroplane. In particular, the required size of the aerodrome was found to decrease as the angle of climb increases and as the stalling speed decreases.

The Chemical Constitution of Thyroxine.

ALTHOUGH the stimulant action of the thyroid gland upon the general metabolism of the body has been recognised for more than a generation, yet it is only within the last decade that the isolation of a pure crystalline principle, possessing the stimulating effects of the whole gland, has been successful. This was first accomplished by Kendall in 1914; since then this author has described a number of the derivatives of the pure substance, which he called "thyroxin," and has suggested a structural formula for it. Our knowledge of it has now been carried a step further by Harington, who has improved the method of extraction so that it gives a much higher yield than Kendall's method, and has proceeded, with the larger amount of material thus available, to determine its chemical constitution by methods of degradation and synthesis. Although at present synthesis has only been carried to the penultimate stage, there is every reason to hope, considering the way in which the author has unravelled the constitution of this compound, that the complete synthesis will soon be successful.

Before describing Harington's work, a few words may be said about the physiological properties of thyroxine. This subject, together with some recent work on its derivatives, has been reviewed by Kendall in his Chandler lecture ("Influence of the Thyroid Gland on Oxidation in the Animal Organism." By E. C. Kendall. New York: Columbia University Press; London: Oxford University Press, 1925. Price 3*s.* net). The activity of thyroxine in stimulating metabolism is remarkable: 1 mgm. injected intravenously in a patient suffering with myxœdema will increase the basal metabolic rate 2.5 per cent., corresponding to an increased output of 400 gm. carbon dioxide; the effect is, within limits, proportional to the dose. Moreover, the time relations of the response are characteristic. Thus, in a normal adult there is a latent period of six to eight hours; thereafter the metabolic rate rapidly increases but the maximum is not reached until the eighth or tenth day. The metabolism then returns slowly to normal, the rate of fall depending on the amount present in the body. A dose of 5-10 mgm affects the metabolism for five or six weeks. It can replace the administration of dried thyroid gland in the treatment of cretinism and myxœdema; in a normal person, not only is the metabolism increased, but also the signs and symptoms of over-activity of the thyroid gland are also produced. Under normal conditions the thyroxine formed in the body appears to be responsible for about 40 per cent. of the metabolism, since complete thyroid deficiency causes a drop in the basal metabolic rate of this order.

The principle of the method of extraction from the thyroid gland is hydrolysis with alkali, followed by precipitation of the filtrate with acid, but whereas Kendall used 5 per cent sodium hydroxide, Harington found that 10 per cent. barium hydroxide resulted in a greatly increased final yield (C. R. Harington, *Biochem. Journ.*, vol. 20, 293, 1926). After about six hours' boiling of the dried thyroid in ten volumes of alkali, 60-70 per cent. of the total iodine appears in the filtrate; 40 per cent. of this can be precipitated on acidification as a creamy flocculent precipitate. The latter requires further hydrolysis with the alkali, when about half the iodine remains in solution and half is carried down with the insoluble barium salts; the latter contain the thyroxine. The precipitate is boiled in alkaline sodium sulphate solution to remove the barium and the filtrate precipitated with acid. The precipitate of crude thyroxine can be further purified by solution in alcohol made alkaline with caustic soda and re-precipitating with acetic acid. Further material is obtained from the gland residues by boiling with caustic soda, adding sodium sulphate, filtering and precipitating the thyroxine in the filtrate with acid. After re-crystallisation, by dissolving in alkaline alcohol and adding acid, further purification is effected by dissolving in dilute hot sodium carbonate, when the sodium salt separates out on cooling. This is re-dissolved in alkaline alcohol and the thyroxine precipitated with acid. The pure substance crystallises in rosettes and sheaves of fine needles. On heating, it darkens at 220° C. and melts with decomposition and evolution of iodine at 231°-233° C. It is insoluble in water and organic solvents; it is soluble in cold dilute solutions of alkali hydroxides, but insoluble in acids. It is soluble in 90 per cent. alcohol with the aid of either alkali hydroxide or mineral acid. The yield was about 0.027 per cent. of the fresh, or 0.12 per cent. of the dried gland, corresponding to about 14 per cent. of the total iodine originally present; Kendall's yield was 0.0011 per cent. of the fresh gland. The physiological activity of the material extracted by Harington's method was shown to be the same as that of thyroxine prepared by Kendall's process.

The compound contains 65.3 per cent. iodine; analysis led to the empirical formula $C_{15}H_{11}O_4NI_4$; Kendall's formula is $C_{11}H_{10}O_3NI_3$, and the difference between the two is due to the fact that Harington found a lower nitrogen content than Kendall. The former observer confirmed his analysis, however, on a commercial sample of thryoxine prepared according to Kendall's process. Kendall considers thyroxine to be triiodo-dihydro-oxindole propionic acid; Harington considers it to be the tetraiodo substitution derivative of the parahydroxy-phenyl ether of tyrosine.

The arguments in favour of the latter appear conclusive: the products of disintegration of the molecule have been identified; the foundation of the molecule has been synthesised and only requires the addition of the iodine atoms to become identical with the original thyroxine. The first step in the breakdown of the molecule is the removal of the iodine; this Harington accomplished by shaking a dilute alkaline solution in an atmosphere of hydrogen with a palladium hydroxide–calcium carbonate catalyst. The iodine was split off as potassium iodide, and the hydrogen taken up was exactly equivalent to the iodine removed. The resulting compound was called desiodo-thyroxine (*Biochem. Journ.*, vol. 20, 300, 1926). Its formula was found to be $HO . C_6H_4 . O . C_6H_4 . CH_2 . CHNH_2 . COOH$.

The interest of the subject appears to justify a somewhat detailed account of the successive steps in the disintegration and synthesis of desiodo-thyroxine. The facts that the latter gave positive Millon's and ninhydrin reactions, and that all the nitrogen was present as amino nitrogen, suggested that the compound was an α-amino-acid with at least one phenolic group; the proportions of carbon and hydrogen suggested the presence of two benzene rings. Fusion with potassium hydroxide produced parahydroxybenzoic acid, quinol in varying amounts according to the conditions, ammonia, oxalic acid, and a substance with the formula $C_{13}H_{12}O_2$. The latter possessed only one phenolic group; the experiment thus suggested the presence of two benzene rings, one of which has a phenolic group in the para position to a side chain, from which a two-carbon fragment is split off as oxalic acid.

Exhaustive methylation of desiodo-thyroxin gave

a product which lost trimethylamine on boiling with alkali and yielded an unsaturated acid, $C_{16}H_{14}O_4$, containing only one methoxyl group. On oxidation with potassium permanganate, oxalic acid and $C_{14}H_{12}O_3$ were formed; the latter was found to be an aldehyde which on further oxidation yielded an acid $C_{14}H_{12}O_4$. Thus methylation shows that desiodo-thyroxin is almost certainly an amino acid, and that it contains only one phenolic group; the splitting off of oxalic acid suggests the presence of a three-carbon side chain. Now fusion with potash led to the conclusion that two benzene rings are present; if linked through a carbon atom, a ketone should have been formed instead of an aldehyde on oxidation of the methylated product; hence they must be linked either directly or through the oxygen atom, which is still unaccounted for. Considering the latter supposition the more probable, the author proceeded to meet the degradation by synthesis.

The steps in the disintegration by exhaustive methylation and in the subsequent synthesis may be rendered clearer if the following structural formulæ are given:

Desiodo-thyroxin. $HO.C_6H_4.O.C_6H_4.CH_2.CHNH_2.COOH$.
$C_{16}H_{14}O_4$ (unsaturated acid) $CH_3O.C_6H_4.O.C_6H_4.CH:CH.COOH$.
$C_{14}H_{12}O_3$ (aldehyde) $CH_3O.C_6H_4.O.C_6H_4.CHO$
$C_{14}H_{12}O_4$ (saturated acid) $CH_3O.C_6H_4.O.C_6H_4.COOH$.
$C_{13}H_{12}O_2$ (from potash fusion) $HO.C_6H_4.O.C_6H_4.CH_3$.

The starting-point in the synthesis was parabromanisol, $CH_3O.C_6H_4.Br$; on condensation with the potassium salt of paracresol in the presence of copper bronze, 4 (4′ methoxyphenoxy) toluene, $CH_3O.C_6H_4.O.C_6H_4.CH_3$, was formed. On boiling with hydriodic acid, the compound $C_{13}H_{12}O_2$ was produced, whilst on boiling with permanganate the toluene compound was oxidised to the corresponding benzoic acid, $C_{14}H_{12}O_4$.

The complete synthesis of desiodo-thyroxin was carried out by a slightly different route; parabromanisol was condensed with potassium phenate to give (4′ methoxyphenoxy)-benzene, from which, by the hydrocyanic acid method, the aldehyde $C_{14}H_{12}O_3$ was obtained. The latter could be oxidised to the acid $C_{14}H_{12}O_4$. From the aldehyde both the acid $C_{16}H_{14}O_4$ and desiodo-thyroxin were synthesised; two methods were used in the case of the latter. The aldehyde was condensed with glycine anhydride in the presence of acetic anhydride and sodium acetate; the product on boiling with hydriodic acid and red phosphorus underwent simultaneous reduction, demethylation and hydrolysis, with the production of desiodo-thyroxin. In the alternative method the aldehyde was condensed with hydantoin, which on boiling with the same reagents yielded the desired product.

As regards the position of the iodine atoms in thyroxine, the author considers that it is probable that two are present in each benzene ring, in each case lying on either side of and next to the oxygroups, *i.e.* in the 3, 5, 3′, 5′ positions. The details of the final synthesis will be awaited with interest.

Annual Visitation of the National Physical Laboratory, Teddington.

On Tuesday, June 22, the General Board of the National Physical Laboratory made its annual visitation of the Laboratory. As in previous years, a large number of members of scientific institutions, technical societies, Government departments, and industrial organisations were also invited to be present. The visitors were received by Sir Ernest Rutherford, president of the Royal Society and chairman of the General Board, and the Director.

The extensive programme of exhibits illustrated well the comprehensive nature of the work which the Laboratory undertakes

In the 14-foot wind channel a model of the Cierva autogyro, which has aroused so much interest in aeronautical circles, was undergoing test. The model is mounted on three supports forming an inverted pyramid. The vertical forces on the feet of these supports can be measured, enabling the three component forces on the model to be determined, and quantitative data to be obtained for comparison with the conventional type of aeroplane. Another exhibit showed experimental arrangements for the investigation of the spinning characteristics of a model aeroplane. The model under test is mounted on an axis parallel to the wind direction in such a manner that its incidence can be varied. Examination of its behaviour permits the main features of the spinning motion to be studied so that it is possible to indicate what features in design are undesirable from this point of view.

In one of the smaller wind channels experiments were in progress to determine the convective dissipation of heat from the surface of an aerofoil in a wind current. Thin strips of platinum foil cemented to the entire aerofoil and parallel to the span can be heated electrically. Their temperatures can be determined by resistance measurements and equalised by adjustment of the currents traversing them. Measurements of their resistance and of the currents determine the rates of loss of energy from the individual strips.

A new 1-foot wind channel has been added to the equipment of the Department. This is intended primarily for the development and calibration of instruments for measuring wind speed and direction.

Among the exhibits of the Metallurgy Department were eight samples of British Standardised Steel, issued jointly by the Iron and Steel Institute and the National Physical Laboratory. These comprised four carbon standards containing respectively 0·10 per cent., 0·27 per cent., 0·65 per cent., and 1·00 per cent. of carbon, two sulphur standards containing respectively 0·027 per cent. and 0·071 per cent. of sulphur, one standard containing phosphorus (0·029 per cent.) and one manganese (0·66 per cent.). These standards are prepared from fine millings taken from six-inch bars Millings taken from the outer layers and the core are rejected, samples of the remainder being subjected to analysis by the Laboratory and various co-operating authorities.

Specimens of pure elements prepared in the Department were also on view. Mention may be made of two of these with which some advance has been made, namely, beryllium and silicon. The former is prepared by the electrolysis of a mixture of the fluorides of beryllium, sodium, and barium, a rotating cathode being used. This is slowly withdrawn at a predetermined rate with the pure metal adhering Special precautions are taken to prevent contamination of the metal by enclosing the salts in special crucibles. Specimens of these made of magnesia and alumina were shown in the foundry. For work on the constitution of silicon-aluminium alloys and on age hardening in aluminium alloys, very pure silicon is required. Samples were shown of 99·8 per cent. purity. Another exhibit illustrated the microscopic examination of metals usually liquid at ordinary temperatures. Such materials as are used in dental practice are included in this category. By surrounding them with a freezing mixture of carbon dioxide snow and acetone, it is possible to polish the surface to the degree requisite for microscopic examination.

In the William Froude National Tank a model self-propelled single screw vessel was shown under test. Simultaneous measurements were recorded of propeller thrust, shaft revolution, and distance travelled. These enable the propeller torque and power expended under varying conditions produced in the tank to be compared, and permit the losses due to the propeller, hull, and sea conditions to be apportioned.

In the Engineering Department research was in progress on the mechanical properties of metals and alloys for use at high temperatures, such as are experienced in modern steam engines and gas engines. At high temperatures metals generally used undergo continuous creep under steady loads, lower than those obtained in normal tensile stress determinations. Experimental work is being done to determine the rate of creep of such materials at various temperatures. For this purpose the test pieces are surrounded by an electric furnace maintained at the required temperature, a steady load being applied by a lever system. Any elongation can be measured by means of micrometers attached to the apparatus. Fatigue can also be studied in a special machine in which the stresses are produced by means of an alternating current, the specimen being heated in position by heating coils.

An investigation was also being carried out on the impact strength of chains. Normally chains are annealed periodically in order to counteract any tendency to embrittlement and the tests were designed with the view of determining the effect of this annealing on the strength of the chain. Of interest also was a trough in which the production of capillary and gravitational waves in water by means of a current of air acting on the surface was demonstrated.

In the Metrology Department, apparatus was shown for the absolute measurement of end gauges up to 4 in. in length. The gauge is converted into a Fabry-Perot étalon by means of two optical flats wrung on to its end faces, the flats having portions extending beyond the edges of the gauge, these portions being semi-silvered on their inside faces. When placed in a convergent beam of monochromatic light, interference fringes in the form of concentric circles are produced. Measurements of the angular diameter of such fringes in various monochromatic radiations enable the optical length between the two semi-silvered surfaces to be determined. The semi-silvered flats are produced at the Laboratory by the method of cathodic deposition, the glass to be silvered being placed near a silver cathode in a vacuum chamber. The apparatus employed for this purpose was on view. A monochromator, designed and constructed for use in connexion with interference measurements, was also exhibited.

In the workshop was apparatus for the study of the deformation of pivots under load. The pivot to be tested is mounted so that its point can be brought into contact with a flat sapphire by a balance arm. An image of the pivot is projected on to a screen and measurements made without and with a load in the balance pan, the magnification being 200 times.

A very large number of exhibits was shown in the Physics Department. Among these was apparatus for the determination of the thermal conductivities of materials at high temperatures by the measurement of the radial gradient in an electrically heated rod of the material.

A resistance bridge for platinum thermometry, made to the design of Mr. F. E. Smith and capable of measuring temperatures to 0·001° C., was exhibited. To obtain this accuracy special precautions are taken to control not only the temperature of the oil tank in which the coils are immersed but also the humidity of the oil, since this latter factor affects the resistance of the coils.

A new apparatus has also been designed for the purpose of measuring the change of length of 'constant length' type bubbles in spirit-level tubes under extremes of atmospheric temperatures likely to be encountered in surveying practice, namely, − 18° C. to 55° C. For this purpose an optical device is used by means of which both ends of the bubble are viewed simultaneously and brought into coincidence, the length being determined in one observation. In this apparatus special attention is given to the geometrical design of the moving parts and to the fine adjustments.

A variety of problems connected with refrigeration were being investigated for the Engineering Committee of the Food Investigation Board. These included apparatus for measuring the heat evolution in fruit by a process which may be compared with that of respiration in animals. In this apparatus a differential arrangement is used in which the heat evolved by apples is balanced by that from an electrical supply. For comparing the relative values of the resistance to indentations of specimens of cork slab and other heat-insulating materials, an apparatus has been constructed in which the depth of penetration of a steel ball about 3 in. in diameter is measured by a dial indicator.

Several forms of the Ewing ball and tube flow-meter were shown. In this instrument a glass or metal sphere is placed in a glass tube of conical bore and the displacement of the ball under the action of the flow of liquid is observed.

In the Optics Section was shown the "Vector" colorimeter, an instrument which enables colour to be specified by measurements involving colour-matching only. In use the colour to be tested is matched first against a mixture of extreme red with some suitable monochromatic light and then against a mixture of spectrum blue with another suitable monochromatic constituent. These matches determine two vectors on a colour chart and the intersection of these determines the unknown colour. Other apparatus included a flicker photometer for heterochromatic photometry and a spectrophotometer not involving polarising constituents.

In the Radiology Section was shown a new X-ray tube with detachable electrodes. In this tube, porcelain is substituted for the glass and the electrodes are fitted with rubber washers. The arrangement allows the tube to be dismantled for cleaning or other purposes and reassembled in a very short time. Apparatus for the study of the wave-forms of high tension generators by oscillographic methods was also shown working. By means of optical trains the wave-forms to be examined, together with a time curve from a tuning fork, are simultaneously recorded on a photographic plate.

In the Electrotechnics Department was shown a method of measuring high voltage dielectric loss. The Schering bridge is a capacity bridge specially suited for measurements of power losses at high voltages and small power factors; it ensures safety to the observer together with the accuracy attainable by other methods. Thus the method is applicable to the study of small phase defects in condensers. Power factors of 1 per cent. can be measured correct to 1 per cent. The dielectric loss in a cable at 20,000 volts was being investigated; in this application the vibration galvanometer and bridge operating arms need never be more than 2 volts above earth potential.

Research work was being carried out in the Direct Current Section on the earthing of electric circuits. Various forms of earthing electrodes suitably spaced are sunk in the ground, and their resistances determined

and compared under varying conditions of soil humidity.

In the Photometry Division a large integrating sphere 10 feet in diameter, constructed by the Metrology Department, was shown in use. It is intended primarily for the photometry of large illumination fittings. Apparatus has also been installed for the purpose of measuring candle-power by means of photo-electric cells. Light from the lamp under test falls on a rubidium cell mounted at one end of a photometer bench. A lamp mounted in a whitened cube, in the floor of which is a second cell screened from the direct light of the lamp, provides a suitable source for comparison. The cells, connected in series, are arranged to form part of a Wheatstone bridge and their currents are balanced by suitable adjustment of the illumination. In the illumination building experimental arrangements were shown for determining the daylight illumination in large or small rooms by means of models. Such information indicates the probable behaviour of their full scale prototypes with regard to daylight and is thus of value in architecture.

In the Wireless Division experience has shown the importance of complete screening of local oscillators and receivers from local electrical disturbances. Several pieces of apparatus, so protected, and including oscillators and receiving apparatus, a variometer and a model frame aerial, were exhibited. The knowledge has been used in the case of amplification tests on valve amplifiers. The amplifier under test and the local oscillator are both carefully protected, the former being placed in a specially screened room. Experimental work in connexion with short wave transmission is also being developed and various transmitting and receiving circuits were on view.

In the Electrical Measurements Department, in addition to the usual equipment, were various quartz piezo-electric resonators for use as radio frequency standards. These, on account of their constant frequency, are very suitable for the control of oscillators. One such oscillator with amplifying valves designed to produce radio frequency oscillations of great power and extremely constant frequency has been installed. L. J. C.

University and Educational Intelligence.

BIRMINGHAM.—The annual degree congregation was held on July 3. There were 6 successful candidates for the degree of Ph.D., 9 for M.Sc., 77 for the degree of B.Sc. with Honours, 48 for the ordinary B.Sc., and 24 for M.B., Ch.B. The degree of Doctor of Medicine was conferred on Gladys Mary Evans and Mr. Victor Goode Williams.

Dr. Laurence Ball, assistant to the chair of medicine and physician to the Queen's Hospital, has been appointed joint professor of medicine to fill the vacancy caused by the resignation of Prof. Kauffmann.

BRISTOL.—Sir George Wills, Pro-Chancellor and chairman of the Council of the University, has given 25,000*l*., to be used with the 110,000*l*. which he presented two years ago, for the erection of a residential hall for students.

CAMBRIDGE.—The Mayhew Prize in applied mathematics has been divided between J. A. Gaunt, Trinity College, and A. H. Wilson, Emmanuel College. The Rex Moir Prize in mechanical sciences has been awarded to H. L. Cox, Emmanuel College, and the John Bernard Seely Prize in aeronautics to R. E. Stevenson, St. John's College.

DURHAM.—Dr. Arthur Holmes, hitherto reader in geology, has recently been made professor of geology at Durham. Two new lectureships have been filled by the appointment of Dr. R. K. Schofield (physics), and of Dr. G. H. Christie (chemistry).

LONDON.—A University post-graduate travelling studentship of the value of 275*l*. has been awarded to Miss C. L. T. Lucas. Miss Lucas obtained the B.Sc. with honours in zoology as an internal student of Bedford College in 1923, and has worked since at the London School of Tropical Medicine. She proposes to carry out research on Amœbæ living in insects, chiefly at the Johns Hopkins University, Baltimore.

ST. ANDREWS.—The degree of D.Sc. in engineering has been conferred upon Mr. William John Walker for a thesis entitled "Developments of Engineering Thermodynamics. Analysis for Variable Specific Heat Conditions." Dr. Walker has resigned the post of lecturer in mechanical engineering and machine design held by him in University College, Dundee, having been appointed professor of mechanical engineering at the University of the Witwatersrand, Johannesburg.

PROF. A. E. MORGAN, professor of English language and literature in the University of Sheffield, has been appointed principal of University College, Hull.

DR. W. E. CURTIS has been appointed professor of physics and director of the Physics Department at Armstrong College, Newcastle-on-Tyne, in succession to Prof. Henry Stroud, who retires at the end of the present session. Dr. Curtis, who is at present reader in physics in King's College, London, was educated at the Imperial College of Science and Technology, London, and was for a time lecturer in physics in the University of Sheffield. He is the author of important papers on spectroscopy.

THE third Congress of the Universities of the Empire will be in session at Cambridge on July 13-16. The subjects for discussion and the names of the chairmen are as follows: "The State and the University," Lord Balfour; "The Desirability of establishing in London a School of Advanced Legal Studies," the Lord High Chancellor; "Co-operation in Research throughout the Empire," Lord Londonderry; "Mutual Recognition of Examinations and of Time spent in Study Elsewhere," Sir Matthew Nathan; "The Desirability of making Provision for the Physical Welfare and Training of Students and the Organisation of Athletics with a View to securing more general Participation," the Duke of Devonshire; "The Actual Working of the Ph.D. Scheme," Viscount Cecil of Chelwood; "The Desirability of Articulating other Pension Schemes with the Federated Superannuation System of Great Britain and Ireland," Lord Haldane. Among the invited speakers on "Co-operation in Research" are Sir Thomas Holland, Sir John B. Farmer, Sir Arthur Shipley, and Dr. Andrew Balfour; on the Ph.D. scheme, Mr. R. A. Priestley, Prof. Wenley, of the American University Union, Prof. Dobson of Bristol, and Prof. H. P. Newton, of King's College, London. Representatives of India, Australia and Canada, as well as Sir Alfred Hopkinson and Sir Theodore Morison, are among those who have promised to contribute to the discussion on "The State and the University." The sessions at Cambridge will be preceded by series of visits by delegates from overseas to all the other universities of Great Britain and Ireland. On July 12 there will be a Government luncheon in honour of the delegates, at which Lord Peel will preside, and in the evening they will have an opportunity of meeting the members of the second Anglo-American conference of professors and teachers of history at a reception given by the University of London.

Contemporary Birthdays.

July 10, 1854. Dr. George Lindsay Johnson.
July 11, 1857. Sir Joseph Larmor, F.R.S.
July 12, 1863. M. Léon Charles A. Calmette, For. Mem. R.S.
July 12, 1869. Prof. Charles Riborg Mann.
July 13, 1869. Prof. Frederick W. Gamble, F.R.S.

Dr. LINDSAY JOHNSON, whose studies in ophthalmology have had practical issues in South Africa as well as in England, was educated at Owens College, Manchester, and Caius College, Cambridge. He has written memoirs on the refraction and vision of the seal's eye; and on the pupils of the Felidæ. A monumental paper, brilliantly illustrated in colour, appeared in the *Philosophical Transactions* for 1901, entitled, "Contributions to the Comparative Anatomy of the Mammalian Eye, chiefly based on Ophthalmoscopic Examination."

Sir JOSEPH LARMOR was born at Magheragall, Co. Antrim, and educated at the Royal Belfast Academical Institution, Queen's College, Belfast, and St. John's College, Cambridge, of which College, since 1880, he has been a fellow. Following professional teaching in Ireland, he was for eighteen years a lecturer in mathematics in the University of Cambridge and in 1903 was elected Lucasian professor of mathematics. From 1901 until 1912 Sir Joseph was one of the secretaries of the Royal Society, a period of fruitful activities In 1915 he was awarded the Royal Society's Royal medal at the hands of Sir William Crookes, who remarked that the recipient's chief claim lay possibly in the establishment of the theory that radiant energy and intramolecular forces are due to the movements of minute electric charges. The theory was sustained in his treatise "Æther and Matter." In 1921 Sir Joseph was awarded the Copley medal. Mention should be made of his extended and masterly obituary notice of Lord Kelvin, published by the Royal Society in 1908.

M. CALMETTE, the accomplished assistant director of the Pasteur Institute, Paris, was born at Nice. Honorary professor of bacteriology and hygiene in the University of Lille, he is a commander of the Legion of Honour. In 1921 M Calmette was elected a foreign member of the Royal Society of London He is Hon. LL.D., Cambridge.

Prof. CHARLES R. MANN was born at Orange, New Jersey. After graduating at Columbia University he studied at the University of Berlin. John Tyndall fellow in physics at Columbia, 1892–95, he was afterwards professor of physics in the University of Chicago from 1896 until 1914. Prof. Mann acted as special investigator (1914–19) of engineering education for National Engineering Societies, and the Carnegie Foundation for the Advancement of Teaching. Author of several standard works on optics, he has written "The American Spirit in Education" (1919).

Prof. GAMBLE, a Manchester man, was educated there at the Grammar School, and at the University, serving after graduation on its zoological staff for some time. In 1909 he was appointed to the chair of zoology in the University of Birmingham. President of the Zoology Section at the Toronto meeting of the British Association in 1924, he gave an address on "Construction and Control in Animal Life."

Societies and Academies.

LONDON.

Geological Society, June 9.—W. D. **Lang**: *Naos pagoda* (Salter): the type of a new genus of Silurian corals. The detailed structure of the hitherto overlooked species *Ptychophyllum pagoda* Salter is described; it is intermediate between Ptychophyllum and Chonophyllum (in their proper interpretation), and the new generic name Naos is proposed.—J. F. **Jackson**: The junction-bed of the Middle and Upper Lias on the Dorset coast. Deposits of *Harpoceratoides hemera* have been traced throughout the 'Western Cliffs' and a richly-fossiliferous representative of part of the 'transition-bed' of the Midlands has been found at Doghus Cliff. A compact limestone crowded with well-preserved fossils in the marlstone at Thorncombe Beacon appears to be transitional from the sandy clay below the junction-bed, but it is probably a case of pseudo-sequence due to deposition on a sea-bottom of incoherent materials. The strata at Watton Cliff were measured and photographed *in situ*. All the evidence indicates slow accumulation under perfectly tranquil conditions. The massive lithographic limestones contain re-deposited matter, and were formed under much less tranquil conditions.—P. G. H. **Boswell**: A contribution to the geology of the eastern part of the Denbighshire moors. The eastern part of the area, about 72 square miles in extent, between Llanefydd, Denbigh, Ruthin, and the centre of the moors is discussed. The greater part of the area consists of Upper Salopian strata, comprising rocks belonging to the zones of *Monograptus nilssoni*, *M. scanicus*, and *M. tumescens*, but the succession is much obscured by a thick mantle of glacial drift. The sediments are all of shallow-water facies, increasing in coarseness as they become younger, and this is attributed to the filling-up and shallowing of the geosyncline. Tectonically, the area constitutes the north-eastern part of the syncline of the Denbighshire moors, pitching north-eastwards. The dominant faults are of north-and-south trend, but swing north-north-westwards in the northern part, and apparently south-south-westwards south of the district. The structure is interpreted as the result of successive upthrows towards the west, but some lateral movement is probable Numerous cross-faults, usually antedating the north-and-south faults, carve the country into blocks. While much of the faulting is of pre-Carboniferous age and related to the folding, movement on the north-and-south faults was, at least in part, renewed in post-Carboniferous times.

Linnean Society, June 10.—J. G. **Dollman**: Exhibition of a supposed new 'mutation' in the rabbit. The specimen showed the fur thickly interspersed with what appeared at first glance to be 'bristles' an inch or more in length. The 'bristles' were the awns of an Australian grass of the genus Stipa, the fruits of which had implanted themselves in the fur of the rabbit.—I. H. **Burkhill**: Exhibition of Hawaiian volcano plants. Eight mature vascular plants from the surface of one-year-old lava in the crater of Kilauea, Hawaii, three being sedges and five grasses, were found in cracks of the lava-flow of 1924 at places where steam issued. Within the steam-cracks was a mass of the genus Trematodon, its capsules weighted down with condensed water; algæ were observed, as well as a number of sporeling ferns and three small dicotyledons, but none of them were mature enough for identification. On lava three years older isolated plants of *Vaccinium penduliflorum* Gaudich, and *Cyathodes tameiameiæ* Cham existed where steam

being absent, the surface was sheltered by boulders from the perennial north-east trade-wind. But neither of these two species, which seem to be the most xerophytic of the local plants, nor any other broad-leaved plants were observed upon the 1924 lava, which lava alone was hot enough to return rain as steam. The drying is obviously a greater hindrance to encroaching vegetation than the sterility of the lava.—T. A. **Sprague**: The taxonomic position of the Adoxaceæ. The position of Adoxa depends primarily on the interpretation placed on the two perianth whorls, those who regard these as 'calyx and corolla' or 'involucre and corolla' placing the genus near the Caprifoliaceæ, whereas those who regard them as 'involucre and calyx' place it next the Saxifragaceæ or Araliaceæ. The former hypothesis involves fewer assumptions than are required by the other hypothesis, and the evidence from abnormal or rarer types is greatly in its favour. It is suggested that the Adoxaceæ should be placed in Rosales — Saxifragineæ beside Saxifragaceæ. — S. K. **Mukerji**: The vegetation of Kashmir: a contribution to the ecology of the Kashmir Himalayas. Investigation of the plant communities of the Kashmir Himalayas was undertaken during the years 1918–24. Three regions are recognised: the aquatic and marsh vegetation of the Dal Lake of Kashmir; the plant communities of the temperate region of the Kashmir Himalayas (5000-9000 ft.); the sub-Alpine and Alpine vegetation of the Kashmir Himalayas (9000-18 000 ft.).

Physical Society, June 11.—J. H. **Awbery** and Ezer **Griffiths**: The latent heat of fusion of some metals. The method of mixtures was used and refinements were introduced, of which the chief were the use of fairly large charges of metal (of the order of 2 kilograms), and a device by which the hot charge was not allowed in contact with the water of the calorimeter until the latter was completely closed. This device consisted in the provision of a sheet-metal vessel suspended by threads from the main lid of the calorimeter. The aperture through which the charge was introduced was closed by a rotating lid, in the main lid, and the crucible being introduced, was submerged after the closing of this smaller lid by means of a wire passing through an eyelet in the base of the calorimeter, and out at the top.—D. W. **Dye**: The piezo-electric quartz resonator and its equivalent electrical circuit. Such a resonator can be represented by an inductance, a resistance and a capacity all in series. These are pictured as in parallel with another small condenser and the whole is in series with a third condenser, the additional condensers representing air-gaps. The agreement between theory and experiment holds for longitudinal resonators of a frequency so low as 44,000 and for transverse resonators with a frequency up to 15,000,000 periods per second. The temperature coefficient of frequency of a considerable variety of resonators is examined over a range of temperatures up to 40° C.; very diverse results are obtained. The effects of displacement of the resonator from the position of centrality are small but not quite negligible. —Evan J. **Evans**: The current-voltage characteristics of electrostatic machines when supplying current to non-inductive loads and to a Coolidge X-ray tube. A large electrostatic machine was used as a source of potential for the discharge through (*a*) a Coolidge X-ray tube, and (*b*) a non-inductive resistance. In the former case, above a certain critical voltage the discharge is intermittent, while in the latter case the discharge is continuous for all voltages. The intermittence observed is due to the operation of the Pearson-Anson effect, and this implies that the effect of the residual gas in such tubes is not completely insensible above a certain voltage.

DUBLIN.

Royal Irish Academy, June 14.—J. **Doyle**: The ovule of Larix and Pseudotsuga. The ovule of all species of Larix is provided with a large outgrowth on the cone-axis side of the micropilar edge. It is definitely one-sided, and covers the mouth like a hood; the other edge of the slit-like micropilar mouth is unchanged. The outgrowth has a stigmatic function, receiving the pollen and afterwards bending over and in, thus bringing the pollen into the micropilar canal. In Pseudotsuga the micropilar mouth is more slit-like and both edges are differentiated, the cone-axis side being prolonged into a large mass as in the Larix, the scale side forming a second lip very much smaller. Though thus two lipped, it is only the larger one which functions as a pollen-receiving device in a manner strictly similar to Larix. The natural and very close relationship in most characters, except habit, between Larix and Pseudotsuga is again emphasised.

EDINBURGH.

Royal Society, June 21.—W. H. **Lang**: Contributions to the study of the Old Red Sandstone flora of Scotland. (iii.) On *Hostimella* (*Ptilophyton*) *Thomsoni*. A new specimen of the fossil, originally named by Dawson *Ptilophyton Thomsoni*, is described. The investigation of this has shown that the linear bodies are sporangia, enclosing large winged spores. The specimen by which Kidston demonstrated that this fertile tip terminated a frond-like branch-system is described. The genus, Milleria, is founded to include *M. Thomsoni* (Dawson) and *M. pinnata* (Lang) (iv.) On a specimen of Protolepidodendron from the Middle Old Red Sandstone of Caithness. A unique specimen from the Thurso flagstones, which was referred by Kidston to *Protolepidodendron karlsteini*, P. and B., is described; it is the first record of this genus from British rocks. (v.) On the identification of the 'Large Stems' in the Carmyllie beds of the Lower Old Red Sandstone as Nematophyton. The striated incrustations, so common in the Carmyllie beds, have been critically investigated. They prove to have the characteristic structure of Nematophyton, which must have been a very abundant plant at this period. Two types are distinguished, the commoner constituting a new species (*N. caledonicum*), while another, with wider tubes, is compared with *N. Forfarense*, Kidston sp.—S. **Williams**: A critical examination of the Vittarieæ. The genera Vittaria, Monogramma (limited to the Eumonogramme section), Antrophyum, Hecistopteris and Anetium, form a natural group. All are tropical epiphytes with creeping dorsiventral rhizomes. The fronds are simple in outline except in Hecistopteris, where they are dichotomously branched. The venation is typically reticulate, but in some species of Monogramma lateral veins are entirely absent. The central type of stele is the dorsiventral dictyostele. The dermal appendages are always clathrate scales, and the epidermis of the fronds is characterised by the presence of spicule cells. The sporangia are constant in structure throughout the group, and the origin of the sorus is probably always intramarginal. The spore output varies from 32 to 64. The gametophyte, where known, is always divergent from the common cordate type. The prothalli are deeply lobed and multiply rapidly by

vegetative means. From a general survey of the structural characters it is concluded that the Vit... must be placed in any natural classification with the complex of genera containing Adiantu... Cheilanthes, Pellæa, Gymnogramme and Ceratopter...—F. R. Cowper **Reed**: Some new Ordovician and Silurian fossils from Girvan. Two new trilobites, one belonging to a genus (Glaphurus) hitherto known only in America, and some other new forms, are described.—Graham **Kerr**: A gigantic poison fang of a snake obtained from the (?) pleistocene of the Gran Chaco. The name *Bothrodon pridii* has been given to the specimen. The fang measured nearly 65 mm. along the convex side, and has a deep poison-groove along its outer side. The uniform curvature, forming practically a semicircle, suggests that the fang was not adapted for striking but rather for the retention of struggling prey while the poison took effect.—G. Donald **M'Intyre**: Development of the vascular system in the human embryo prior to the establishment of the heart. A detailed account of early stages of vascular formation in some embryos, such as have not been hitherto published, and a summary from the original descriptions of the vessels in a number of young human embryos.—J. M. **Whittaker**: On a polarised light quantum. The refraction and frequency of the light quantum of Sir J. J. Thomson and Prof. Whittaker are discussed analytically, and a modification of it is proposed to explain the phenomena of polarisation.—W. W. **Taylor**: (1) Ferric hydroxide sol and the lyotrope series. The concentration of the univalent salts of potassium which just completely precipitates ferric hydroxide sol in twenty-four hours under strictly comparable conditions has been determined. The order is—acetate, thiocyanate, chloride, bromide, nitrate, iodide, chlorate, the concentrations rising from 0·01 n to 0·083 n. (2) Note on a theory of von Weimarn. According to von Weimarn's theory of the colloid state, the duration of life of a sol is longer when a precipitating ion contains the same element, as the sol. Ferric hydroxide sol is completely precipitated in twenty-four hours by the same concentration of ferricyanide as of the trisulphonates, but the zone of partial precipitation is prolonged. With ferrocyanide the corresponding concentration is the same, and the zone of partial precipitation is also similar; there is in this case, however, at higher concentrations a second zone of precipitation, separated from the first by one of no-precipitation.

PARIS.

Academy of Sciences, May 31.—H. **Deslandres**: The distribution in time of terrestrial magnetic perturbations and the corresponding distribution in the sun of the regions which emit a corpuscular radiation. In an earlier communication it has been suggested that the magnetic storms occur at intervals which are multiples of $R/6$, R being the mean duration of the synodic rotation of the spots. A detailed examination of the data for 1882, 1925 and 1926 is made, and the results exhibited in tabular form; they generally confirm the above view.—Gabriel **Bertrand** and M. **Mâcheboeuf**: The relatively high proportion of nickel and cobalt in the pancreas. It has been shown that animal tissues normally contain minute amounts of nickel and cobalt. The distribution of these metals varies with the nature of the tissue, being lowest in muscle and highest in the liver and pancreas. The original figures were obtained from the ox, but examination of the pancreas from several animals (ox, ... pig) proves that the pancreas is always richest in nickel and cobalt. ... found that preparations of insulin contain several hundred times more nickel and cobalt than the glands from which they are extracted. This raises the question whether these two metals intervene in the remarkable action of insulin, and further work on this is in hand.—H. **Vincent**: The general properties of the cryptotoxins, in particular of tetanus cryptotoxin. The name cryptotoxin has been applied to microbial poisons which, in contact with certain substances, lose entirely under this influence their toxic power, keeping, however, some of their properties, in particular their immunising power. Sodium palmitate has been used as the modifying agent, and this salt rapidly neutralises, *in vitro*, microbial toxins. Experiments with guinea-pigs show that this animal can be injected with tetanotoxin 600 times the fatal dose without inconvenience if the toxin has been previously mixed with a suitable proportion of a solution of sodium palmitate. Similar effects are observed with the toxins of diphtheria, dysentery, typhoid, and *B. œdematiens*. The toxins are not really destroyed, since the sodium palmitate complex treated with hydrochloric acid and filtered from the palmitic acid gives a solution producing, in large doses, symptoms of tetanus in a guinea-pig.—Bertrand **Gambier**: The deformation of a surface with conservation of a conjugated network.—Gaston **Julia**: The conformal representation of areas.—Rolin **Wavre**: The construction of a class of functional automorphs relating to a symmetrical nucleus of Fredholm.—G. **Cerf**: The transformation of certain systems in involution of partial differential equations with two independent variables into an equation of the first order.—E. **Gau**: The transformation of a partial differential equation of the second order into an equation of the first order.—André **Roussel**: An extension of the method of Weierstrass.—**Riabouchinski**: Remarks on the problem of cavitations.—Emile **Belot**: The probable limits of the age of the planetary system, according to the theory of radiation and cosmogonic data.—Mlle. M. **Hanot**: The enlargement by absorption of lines of Balmer's series.—Jean **Dufay**: The spectrum of lightning. A study of the part of the spectrum with wave-lengths less than 3850 Å.U.—C. G. **Bedreag**: The complex structure of the spectrum of copper.—P. **Vaillant**: The passage of the (electric) current in solid salts.—F. **Holweck**: Discussions and recent experiments on the soft X-rays. A discussion of the results obtained by M. Dauvillier and the author.—P. **Lebeau** and A. **Damiens**: Carbon tetrafluoride.—Mme. **Ramart** and Mlle. **Amagat**: Molecular transpositions in the series of the α.α.α.-alkyl-diaryl-ethanols.—René **Souèges**: The embryogeny of the Liliaceæ. The development of the embryo in *Allium ursinum*.—J. **Beauverie**: The cytological bases of the theory of mycoplasma.—G. **Ollivier**: *Thalassoascus Tregoubovi* (new genus, new species), a marine pyrenomycete, parasitic on the Cutleriaceæ.—Théodor **Lippmaa**: Hematocarotinoids and xanthocarotinoids.—A. **Quidor** and Marcel A. **Hérubel**: The simultaneous and monocular perception of two different images of the same object.—Jules **Amar**: Radiations and chlorophyll. The green pigment of leaves holds back the red radiations, the complementary colour, and red rays are most compatible with the persistence of chlorophyll.—P. **Vignon**: The anatomy of the organs of flight in the Phasgonurideæ of the present time and in the Protolocustideæ of the coal measures.—Robert **Weill**: The cnidome of the Trachylideæ (Trachymedusa and Narcomedusa).

Official Publications Received.

Práce Moravské Přírodovědecké Společnosti, Brno, Československo. (Acta Societatis Scientiarum Naturalium Moraviae, Brno, Cechoslovakia.) Svazek 1, Spis 1-10 (Tomus 1, Fasciculus 1-10), 1924. Pp. iii+618+11 tab. (Brno: A. Píša.) 100 Kč.

Spisy Lékařské Fakulty Masarykovy University, Brno, Československá Republika (Publications de la Faculté de Médecine, Brno, Tchécoslovaquie). Svazek 1, Spis 1-10 (Tome 1, Fascicule 1-10), 1922-23. Pp. vi+265+14 tab. 40 Kč. Svazek 2, Spis 11-21 (Tome 2, Fascicule 11-21), 1923-24. Pp. ii+312+11 tab. 40 Kč. Svazek 3, Spis 22-32 (Tome 3, Fascicule 22-32), 1924-25. Pp. ii+258+5 tab. 40 Kč. (Brně: A. Píša.)

Biologické Spisy Vysoké Školy Zvěrolékařské, Brno, Československa Republika (Publications biologiques de l'École des Hautes Études vétérinaires, Brno, Tchecoslovaquie). Svazek 1, Spis 1-20 (Tome 1, Fascicule 1-20), 1922. Pp. xv+386. 50 Kč. Svazek 2, Spis 21-40 (Tome 2, Fascicule 21-40), 1923. Pp. iii+343+6 tab. 40 Kč. Svazek 3, Spis 1-10 (Tome 3, Fascicule 1-10), 1924. Pp. iii+276+1 tab. 40 Kč. (Brně: A. Píša.)

Agricultural Research Institute, Pusa. Bulletin No. 160: Bot Flies of the Punjab. By Capt. H. E. Cross. Pp. 16+8 plates. (Calcutta: Government of India Central Publication Branch.) 14 annas; 1s. 6d.

The Indian Forest Records. Vol. 12, Part 4 (Silviculture Series): Yield Table for clear-felled *Sal* Coppice (*Shorea robusta*). By S. H. Howard. Pp. v+19+6 charts. 8 annas; 10d. Vol. 12, Part 5 (Silviculture Series): Yield and Volume Tables for *Chir* (*Pinus longifolia*). By S. H. Howard. Pp. iv+21+10 charts. 1 rupee; 1s. 9d. Vol. 12, Part 6 (Silviculture Series): Yield and Volume Tables for Deodar (*Cedrus Deodara*). Pp. iii+23+10 charts. 8 annas; 10d. Vol. 12, Part 8 (Entomology Series): On some Indian Cleridae (Coleoptera) Part 1: New Species of Cleridae from British India and Burma. By J. B. Corporaal. Pp. 15. 5 annas; 8d. (Calcutta: Government of India Central Publication Branch.)

R. Osservatorio Astrofisico di Catania. Catalogo Astrofotografico Internazionale 1900-0. Zona di Catania fra de declinazioni +46° e +55°. Vol. 1, Parte 2a: Declinaz. da +46° a +48°, ascens. retta da 8h a 6h. Pp. xii+49. (Catania.)

Norman Lockyer Observatory. Director's Annual Report, April 1, 1925-March 31, 1926. Pp. 8. (Sidmouth, Devon.)

The British Institute of Philosophical Studies. Annual Report and Statement of Accounts for the Year ended 31st March 1926, to be Presented at the First Annual General Meeting of the Members to be held at The Royal Society of Arts, 18 John Street, Adelphi, London, W.C.2, on Friday, 18th June 1926. Pp. 16. (London: 88 Kingsway, W.C.2.)

Koninklijk Nederlandsch Meteorologisch Instituut. No. 104a: Supplement; Oceanographische en Meteorologische Waarnemingen in den Indischen Oceaan, Juni, Juli, Augustus (1856 1908) Tabellen. Waarnemingen Noord van 5° N.B. (1856-1923). Pp. iv+24. 1.25 fl. No. 106a: Ergebnisse aerologischer Beobachtungen. 11, 1923. Pp. iv+42. 2.50 fl. (Utrecht: Kemink en Zoon.)

Littlehampton, Sussex. Official Guide, 1926. Pp. 100. (Littlehampton: Urban District Council.)

University of Leeds. Report on the Department of Mining, Session 1924-1925. Pp. 10. (Leeds.)

Statens Meteorologisk-Hydrografiska Anstalt. Årsbok, 7, 1925. ii: Nederbörden i Sverige. Pp. 159. (Stockholm.) 5 kr.

The Sir John Cass Technical Institute, Jewry Street, Aldgate, E.C.3. Report on the Work of the Department of Petroleum Technology, Session 1925-1926. Pp. 4. (London.)

Report on the Health of the Army for the Year 1924. Vol. 60. Pp. iv+146. (London: H.M. Stationery Office.) 3s. 6d. net.

University of California Publications in American Archaeology and Ethnology. Vol. 21, No. 7: The Uhle Pottery Collections from Chancay. By A. L. Kroeber. Pp. 265-304+plates 80-90. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.) 60 cents.

Diary of Societies.

SATURDAY, JULY 10.

BIOCHEMICAL SOCIETY (in Biochemical Department, Museum, Oxford) at 2.30.—H. W. Buston and Prof. S. B. Schryver: The Isolation of a Hydrolysis Product of the Proteins Hitherto Undescribed.—L. G. McGuire and Prof. S. B. Schryver: The Isolation of a Hydrolysis Product of the Proteins Hitherto Undescribed.—L. F. Hewitt: The Rotatory Power and Dispersion of Proteins.—H. A. Abramson, P. Eggleton, and M. G. Palmer: The Fate of Sodium Lactate Injected Intravenously.—C. E. Grover and A. C. Chibnall: Preparation of Asparaginase from the Rootlets of Germinating Barley.—Prof. J. C. Drummond and G. F. Marrian: Relation between Vitamin B and Metabolism.—V. B. Reader and Prof. J. C. Drummond: Relation between Vitamin B and Protein in the Diet.—J. Needham: The Non-protein Nitrogen in the Developing Avian Embryo.—H. W. Dudley, O. Rosenheim, and W. W. Starling: The Constitution and Synthesis of Spermine.—C. G. Douglas: The Ferricyanide Method of Blood-Gas Analysis.—F. Hawking: Synthesis of Antineuritic Factor by Yeast.—V. B. Reader: Effect of the Interfacial Tension of the Medium on the Growth of Streptothrix.—H. W. Kinnersley and R. A. Peters: A Case of Inactivation of Torulin.—Demonstrations by V. B. Reader: Abnormal Growth of *Streptothrix corallinus*; and A. E. Garrod and L. Mackey: Congenital Porphyrinuria.

PHYSIOLOGICAL SOCIETY (in Department of Physiology, University, Sheffield), at 3.—Prof. H. S. Raper and E. C. Smith: Insulin and Acetone Production in the Perfused Liver.—Prof. H. S. Raper and E. J. Wayne: A Quantitative Study of β-oxidation.—H. Florey: The Function of the Lacteals.—A. S. Parkes and C. W. Bellerby: The Œstrus-inhibiting Hormone of the Corpus Luteum.—May Mellanby and C. Lee Pattison: Diet in relation to the Onset and Spread of Caries in Children.—E. Sudie and Prof. E. Mellanby: The Influence of Light on the Antirachitic Action of Foods.—M. H. MacKeith: A Note on the Action of Alcohol on the Perfused Isolated Rabbit Heart.—M. Hurst and C. G. Imrie: Nitrogenous Metabolism in Post-encephalic Rigidity.—C. Tingle and C. G. Imrie: Effect of Pituitrin on Blood Sugar Curves.—E. C. Eaves: Changes in the Pituitary following Repeated Insulin Injections.—E. C. Eaves and G. A. Clark: Changes in the Pituitary after Section of the Right Vagus.—G. A. Clark: Antagonism of Insulin and Pituitrin.—W. H. Newton and B. A. McSwiney: The Reaction of Smooth Muscle to Changes in the H-ion Concentration.—E. N. Willmer: The Influence of Glucose on the Survival of Cells *in vitro*.—A. Hemingway and Prof. R. J. S. McDowall: The Acid-Base Control of the Capillaries.—C. A. Mills: The Rôle of Tissue Fibrinogen in Blood Clotting.—F. W. Lamb and K. R. Fraser: Oxygen Tension in Mixed Venous Blood.—J. P. Hoet: The Action of Pilocarpine on the Spleen.—W. Smith: Insulin and Diastase.—J. C. Bramwell: Analysis of the Phonoarteriogram.—J. C. Bramwell and B. A. McSwiney: Hot-wire Record of the Venous Pulse.—Demonstrations by E. C. Eaves: Changes in the Human Pituitary associated with Abnormalities of Growth.—M. Croll and E. C. Eaves: (*a*) Ductless Glands of a Cretin; (*b*) Changes in the Pituitary produced experimentally in the Rabbit.—G. Wilkinson: The Mechanism of the Cochlea: the Influence of Fluid Load on the Vibration Period of Immersed Membranes.—F. W. Lamb and G. J. Woolham: Records of Muscle Tremor and Muscular Balance.

TUESDAY, JULY 13.

ROYAL SOCIETY OF MEDICINE (Anæsthetics Section—Visit of American and Canadian Anæsthetists) (at 1 Wimpole Street, W.), at 10 A.M.—Papers by Prof. J. S. Haldane, T. P. Dunhill, and Dr. J. Blomfield.

WEDNESDAY, JULY 14.

ROYAL SOCIETY OF MEDICINE (Anæsthetics Section—Visit of American and Canadian Anæsthetists) (at 1 Wimpole Street, W.), at 10 A.M.

THURSDAY, JULY 15.

ROYAL SOCIETY OF MEDICINE (Anæsthetics Section—Visit of American and Canadian Anæsthetists) (at 1 Wimpole Street, W.), at 10 A.M.—American Session.

SATURDAY, JULY 17.

SOCIETY FOR EXPERIMENTAL BIOLOGY (in Department of Natural History, University of Edinburgh), at 10 A.M.—Dr. F. A. E. Crew: The Developmental Capon and Poulard.—E. A. Spaul: The Metamorphic Principle of the Anterior Lobe of the Pituitary.—W. P. Kennedy: Diet and Reproduction in the Rat.—Prof. J. H. Priestley: The Perception and Transmission of Stimulus in the Coleoptile of the Grass Seedling.—L. A. Harvey: The Relation of Cell Inclusions to Cell Metabolism.

MONDAY, JULY 19.

SOCIETY FOR EXPERIMENTAL BIOLOGY (at the Botanical Gardens, Edinburgh), at 10 A.M.—J. Gray: The Growth of Fish.—E. Philip Smith: The Effect of Acidity on Regeneration in Coleus.—J. W. Gregor: The Influence of Environment on the Formation of definite Habitat Types.—K. B. Blackburn: Some Observations on Sex and Chromosomes in Plants.—(In Department of Natural History, University of Edinburgh), at 2.30.—A. Walton: The Survival of Fertilising Capacity of Rabbit Spermatozoa *in vitro*.—A. D. Hobson: The Formation of the Fertilisation Membrane in *Echinus esculentus*.—E. Ponder: The Kinetics of Hæmolytic and Bacteriolytic Reactions.—T. Rettie: Demonstration of a Histological Method for the Early Stages of Cell Injury.

CONFERENCES.

JULY 13 TO 16.

ROYAL MEDICO-PSYCHOLOGICAL ASSOCIATION (at House of British Medical Association).

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JULY 15 TO 17.

OXFORD OPHTHALMOLOGICAL CONGRESS.

JULY 15 TO 19.

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INTERNATIONAL CONGRESS ON ALCOHOLISM (at Dorpat).

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DAY, JULY 17, 1926.

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Bird Protection in Great Britain.

THE re-introduction to the House of Lords a few days ago of a Bill for the Protection of Wild Birds suggests a glance at some aspects of bird protection in Great Britain. The new Bill proposes to repeal the Statutes, nine in number, extending from 1880 to 1908, which regulate the legal protection of birds in this country, and to replace them by a single body of law more in keeping with present-day notions of bird protection, and in some respects more stringent in its defence of the birds and more exacting in the penalties to be demanded from law-breakers.

This consolidation of bird protection legislation is a welcome move, for the multiplicity, and to some extent confusion, of the old laws militated against their successful working, and unfortunately the need for rigorous protection is still clamant. During the present season we have had the unedifying spectacle of a well-known naturalist and observer being heavily fined for abetting in the taking of clutches, twenty-three eggs in all, of the crossbill in Norfolk. In the Grampians, Mr. Seton Gordon found that the golden eagle's eggs which he had under observation were taken from the eyrie after they had been incubated for nearly five weeks, that is to say, when the chicks were on the point of hatching and the eggs could have been of no value to the collector. These cases are symptomatic of a vast amount of raiding of the nests of the rarer birds which is taken part in and encouraged by unscrupulous collectors who have the audacity to put science in the forefront of their excuses. It is almost impossible, however, for the law unaided to check such misdemeanours. They will be discouraged and arrested only when public opinion makes its voice heard with no uncertainty in the matter.

It is gratifying to know that public opinion is awakening to the realities of the situation and that steps have been and are being taken, by the Government, by municipalities, and by private bodies, which should go a long way to arouse interest in a vast section of the public which has few opportunities of observing Nature at large. To the enthusiasm of Sir Lionel Earle, chairman of the Bird Sanctuaries Committee (England), was largely due the formation of that committee, under H.M. Office of Works, and the institution, following on the report of the committee issued in 1922, of bird sanctuaries in the Royal Parks in London. The report for 1925, just issued, shows that the sanctuaries continue to give great encouragement to bird life, and that efforts are continually being made, by increasing the amenity of the reserves from the birds' point of view, to encourage the influx of greater numbers and greater variety of wild birds. Supplementary reports dealing

with the sanctuaries at Hyde Park, Kensington Gardens, Richmond Park, Bushey Park, Greenwich Park, St. James's and Green Park show not only that the reserves were largely used as resting-places by birds on migration, but also that a very considerable variety of wild birds took up their summer residence there. At least 18 species nested in Hyde Park and Kensington Gardens, 47 in Bushey Park, and 55 in Richmond Park.

There can be no doubt that a great part of the success of a small sanctuary depends upon the selection of the proper vegetation, and that the steps taken by the Bird Sanctuaries Committee, with the view of offering an attractive food supply to winter migrants, and suitable shelter for summer residents, have done much to ensure the increasing success of the sanctuaries in the Royal Parks. These steps include the planting of berry-bearing trees and of suitable nesting bushes for summer residents, the thinning out of plantations in order that wild flowers, such as foxgloves, willow-herb, and thistles, may grow and seed, and the sowing of teazles, a winter food particularly favoured by goldfinches.

In Scotland, similar steps have been taken in the Royal Park of Holyrood, where Duddingston Loch with its extensive reed-beds, a much-frequented winter haunt of immigrant ducks, promises to become a reserve of outstanding interest. During the present season, it is recorded by Mr. Kirke Nash that the common pochard, which has not hitherto been known to nest in Midlothian, has reared two broods on the Loch.

In several cases city corporations have taken part in the sanctuary movement, the lead having been taken in Scotland by Glasgow, which has created bird reserves, with feeding-tables and so on, in its public parks. The movement is well fitted to stimulate public interest, for it affords new and hitherto unattainable opportunities to town-dwellers for the observation, if not of nests and eggs, at any rate of adult and young birds at the most interesting stage of their existence. Furthermore, it places before the minds of all and sundry, with steady insistence, the facts that birds have an interest and afford pleasure, and that they require protection. The extension of the municipal formation of bird sanctuaries in public parks is a movement worthy of every encouragement because of its possibilities in moulding a wide appreciation of living things; but it must be recognised that such steps can have no bearing on the pressing question of the protection of the rarer birds which are threatened by the attention of the collector.

For the progress made, no body deserves more credit than the Royal Society for the Protection of Birds. The annual report of this influential society indicates the part taken by the Society's watchers in ensuring the safe breeding in certain localities of some of the rarer birds, such as choughs, Kentish plover, Norfolk plover, Dartford warbler, phalaropes, and others. It points out to how great a degree the extension of motor traffic, the breaking up of great estates, and expansive building, are gradually obliterating woods, parks, and meadows, and spreading disturbance in the countryside. In the result, the homes, haunts, and food supplies of wild birds are being altered, and a steady change is taking place in the character, though not in the numbers, of the bird population. It points out that the destruction of sea-birds caused by the deposition of oil at sea, either as waste from oil-driven ships or as cleanings of tankers, is a problem that still seems far from solution, in spite of the three-mile limit imposed upon such discharge by law. But several nations have taken up this matter with energy, and sooner or later some means may be found through international action of avoiding needless destruction.

The report states that afforestation, which had become an imperial necessity, gave many a qualm to the lover of natural woodlands not planted for profit or grown for the axe. In this connexion, the Government could not do better than emulate the action of the various States of Australia, which automatically convert forests under the charge of Government departments into wild animal reserves. Were similar measures taken in Great Britain with regard to the Government afforestation areas under the control of the Forestry Department, a first and important step would be made towards the protection of the rarer birds and beasts, and towards the realisation of that national park which Britain alone amongst the great nations still lacks.

JAMES RITCHIE.

Physiological Optics and Psychology.

Helmholtz's Treatise on Physiological Optics. Translated from the third German edition. Edited by Prof. James P. C. Southall. Vol. 3: *The Perceptions of Vision.* Pp. xi + 736 + 6 plates. (Ithaca, N.Y.: Secretary, Optical Society of America, Rockefeller Hall, 1925.) 7 dollars.

"To the solid ground
Of Nature trusts the mind which builds for aye."
—WORDSWORTH.

THE issue of this volume completes a great task. The English-speaking public has now at its disposal for the first time an edition in English of the epoch-making work of von Helmholtz as it originally appeared, along with the new material which was included in the third German edition to bring the work up-to-date, and some additional matter specially

included in the American edition. In the present volume, this additional matter, contained in two notes by von Kries, one on the perception of depth, the other on visual rivalry, is less in amount than the corresponding matter in the first two volumes. But the whole volume is considerably larger than either of the others, and about one-third of it is occupied by the notes and the appendix contributed by von Kries, on almost every branch of the subject dealt with, which were added to the third German edition of the text. The notes appear at the ends of the several divisions of the subject, and the appendix is given at the end of the volume. It deals with the nature of the idea of space in general, the relations of normal localisation, localisation and anomalous eye adjustment, learning to see, and forgetting, the physiological foundations of judgment and learning, empiricism and nativism or intuitionalism, the origin of the laws of the ocular movements, historical and critical comments, and the theory of binocular instruments.

The whole subject of physiological optics involves physical, physiological, and psychological questions. The present volume deals specially with the latter and the phenomena which give rise to them. In this department, as in the other two which were specially treated in the first and second volumes, Helmholtz was a pioneer. Much time has elapsed since he wrote his discussion; and it might be expected that much, perhaps radical, change of view may have taken place especially where opposing theories were concerned. Helmholtz realised his position clearly. "It ought to be said in the beginning," he remarks, "that our knowledge of the relevant phenomena is still too limited to justify us in acceptance of any one theory to the exclusion of all the others." "I acknowledge that we are still far from a real scientific comprehension of psychic phenomena." "I frankly admit, however, that these questions under discussion are not altogether ready for final decision. My own attitude to them is due partly to the simplicity of the explanations that are afforded in this way, but especially to systematic considerations also; for I think it always advisable to explain natural processes on the *least* possible number of hypotheses and on those which are as *definitely formulated* as possible." Here we have Helmholtz's creed, which we have already recognised (NATURE, vol. 114, p. 887, vol. 116, p. 88) in rigid application in the physical and the physiological tracts of the subject, carried over scrupulously into the less well-charted psychical region—simple postulation, simple formulation, simple explanation, appeal to facts. "To the solid ground of Nature trusts the mind which builds for aye."

In accordance with this undeviating search for truth as tested by its outstanding characteristics, in accordance with this systematic presentation of it in a form of statement the most easily testable, is there also to be found, in this volume as in the other two, the impress of the hall-mark of time, stamping it as the enduring creation of genius? In answer we need only select, almost at random, words of von Kries, the writer of the notes and the appendix which review and estimate the further advance of the subject during half a century. He takes, in one respect at least, a line of thought differing from that of Helmholtz, but his words are such as these.

"Helmholtz's classical work, published more than forty years ago, was based partly on philosophical considerations, partly on comparatively simple results of direct self-observation, and, partly too, it should be added, on a vast amount of empirical observation in the ordinary sense. But even in this latter respect, in spite of many new facts that have been gleaned and some corrections that have to be made here and there, the material contained in the first edition of the 'Physiological Optics' may still be said to be essentially correct and pertinent."

"Those points in regard to localisation where we have been obliged to differ from Helmholtz (or rather, strictly speaking, where it was found necessary to develop his theory further) are only of secondary importance after all, no matter how much weight may be attached to them."

"It would be therefore a complete misapprehension of Helmholtz's views (as has been intimated sometimes) that he meant to deny altogether the participation of innate factors in the case of localisation. The truth is, rather, that Helmholtz was disposed to think that from his point of view it was extremely probable that there was some kind of co-operation such as we have deemed likely; that is, with respect to the relationship existing between the visual direction and the location on the retina, although he doubted whether such an assumption could be absolutely verified. The fact that modern investigations of strabismus have enabled us to develop still further assumptions of this sort need not imply that any fundamental modification has been made in Helmholtz's theory."

"The main thing to be remembered is that to a great extent these modern investigations have *corroborated* in a very positive manner inferences that Helmholtz had already made from the scant material at his disposal at that time. The main conclusions which he reached have been shown to be absolutely probable."

"The facts tend to support the fundamental conceptions of an empirical theory to a remarkable degree, although perhaps not altogether to the extent that Helmholtz supposed. It would be turning things upside down, it seems to me, to regard these new facts as a corroboration of the points of view of the intuition theory. They are certainly the opposite of what might be anticipated on the basis of those conceptions."

"After all, naturally disposed as I am to agree with many of my *confrères* and to regard learning as being a physiological process, I never have been able to consider this as amounting to any profound or fundamental divergence from Helmholtz's views."

"Helmholtz was absolutely right in disputing the very principle on which the whole nativist conception was based."

"It was stated at the outset (and the fact has been brought out still more clearly in the course of this discussion) that it would be a mistake to think of nativism and empiricism as two mutually antagonistic conceptions involving a choice one way or the other. Experience is placed in the foreground in the empirical theory, and innately determined relations in the intuition theory; and undoubtedly (speaking perfectly generally) both of these things have something to do with our perceptions of space. Here, if anywhere, it will be true that there is a certain amount of justification for each of the two originally conflicting opinions, according to the degree of importance that was attached to one or the other of these things."

"Any one who will follow the argument as here presented will see that the principle which has guided us, and which remains still to-day the best way of obtaining an insight into those problems and is the basis of future investigation, has been the empiricism of Helmholtz, even though it has had to be modified and amplified in many respects."

In the development of any scientific subject, fundamentally unprovable postulates have to be made. In the present case these are the postulates of the innateness of certain ideas or intuitions. The aim in all sciences is to reduce these to a minimum, and Helmholtz, in his development of the subject, strove to push the unexplained intuitional basis as far back as possible. There are three ways in which the expression of conditions may be made in regard to vision: the physical, the physiological, and the psychical. Each of these is equally fundamental and contributive. Each, if the interconnexions were given, is equally valid and available for the expression of the ultimate laws and explanations. Yet Helmholtz's use of the psychological mode of description of the phenomena, for example, especially in regard to phenomena of colour contrast, has been decried as a subterfuge and an error. "The more attentively I have studied the phenomena," he says, "the more I have been impressed by the uniformity and harmony everywhere of the interplay of the psychic processes, and the more consistent and coherent this whole region of phenomena has appeared to me." The whole of his psychic treatment of the phenomena of colour contrast, far removed from the exclusion of future development, can be expressed in mathematical symbols and equations involving the external stimuli and the threshold values which sum up the effects of the internal physical, physiological, and psychic activities.

No mistake is made by von Kries in this connexion. He says: "Some brief allusion may be made to the utter inaptness of an opinion which is sometimes expressed, namely, that, since Helmholtz's views were *psychological*, they had put an end to all further investigation." "In fact we owe it to the 'empiricists' and not to the 'nativists,' that a new and fruitful line of inquiry has been started by studying strabismic vision, for instance." "On the other hand, the feature of the nativist systems that aroused Helmholtz's special opposition must also be pronounced unsound and untenable at present."

Recognition should be made of the unusually fair and careful way in which von Kries states his own views when they differ from those of von Helmholtz. He has attained to that absolute impartiality which is so difficult to reach even in scientific discussion. Alike in judicial fairness, in acuteness of perception, and in concise clearness of expression, his work is worthy of its place alongside that of the master.

The editor of this edition, along with his band of able co-workers, are to be congratulated on the completion of the task of translation. Resting from their labour, they can await the award. For the issue of this edition cannot fail to have its influence on future work in the field with which it deals. It is fitting that its home should be in America, for a strong group of the workers dwells there; but it should, and will, go out into all the world.

W. PEDDIE.

The Future of America.

(1) *Midas: or, The United States and the Future.* By C. H. Bretherton. (To-day and To-morrow Series.) Pp. 96. (London: Kegan Paul and Co., Ltd.; New York: E. P. Dutton and Co., 1926.) 2*s.* 6*d.* net.

(2) *Atlantis: America and the Future.* By Colonel J. F. C. Fuller. (To-day and To-morrow Series.) Pp. 96. (London: Kegan Paul and Co., Ltd.; New York: E. P. Dutton and Co.; n.d.) 2*s.* 6*d.* net.

THESE two small books on a great subject are included in the "To-day and To-morrow" series, designed by the publishers to provide a stimulating survey of the most modern thought in many departments of life. Both are accordingly written in a critical and provocative style, compact with aphorisms. America's place in the world is assured and no resentment will be felt there at attempts to discover chinks in her formidable armour. Of the two books, Mr. Bretherton's is the longer and more careful study. Colonel Fuller's suggests the rapid travel impressions of a writer possessing a mature knowledge of world-history.

What is the basis for the strong and not altogether comfortable feeling that America is destined to exercise a powerful influence on the future of the world? The American, "the new white man," marches round the world with his war drum and the European falls in behind "with many a backward glance at the good old days." Nevertheless, the achievements of the United States in art, literature and science are unimportant in relation to their wealth and population. Jazz music and the skyscraper are "the only two new art forms" which Mr. Bretherton is prepared to concede to America as contributions to civilisation. As to their education, the United States, he says, have countless universities but no educated class "outside of their college professors, who rank in the social scale a little higher than the average preacher, and a little lower than the average bootlegger." The matter can be tested by the output of books. "More books on natural history, botany and country life generally are published every year in England than have been published in the United States since the *Mayflower* landed there. The same is true of almost every other branch of literature outside of fiction."

As to forms of government, were we not given to understand that America wished to make the world safe for democracy? Mr. Bretherton produces no evidence of any genuine enthusiasm for democracy. Professional politicians, fanatics with a mania for inhibitions, bosses and spellbinders pullulate. The American reacts by forming the habit of acting, thinking, living and believing 'by numbers.' Prohibition, it is well known, does not prevent an American from getting a drink. But this necessitates a mental process. "He will in the end decide that it is simpler (and more profitable) to stay dry and reserve his mental processes for money-making." So with Fundamentalism. The vast majority of American people, Mr. Bretherton asserts, are reconciled to evolution and have no quarrel with science, which scatters machines and fertilisers with a fatherly hand. Fundamentalism will 'win through' because big business will decide that the man-machine who pauses intermittently from wielding his shovel to ask himself unanswerable questions about the macrocosm is a shade less efficient—say by one-tenth per cent.—than if he accepted "the Bible as written." "The most striking thing about the young Americans of to-day," says Mr. Bretherton, "is that they know nothing and have no ideas of their own." They are forgetting how to think. Like goldfish, they chase feverishly round a glass globe, seeming in some mysterious way to be unaware of one dimension. Their industry is amazing, whether in money-making or in ticking off the sights of Europe in Baedeker.

Significantly, neither author attempts a chapter on American humour, perhaps because it would have resembled the famous chapter on snakes in Ireland. The discussion of the American woman seems inadequate to the importance of the subject. Mr. Bretherton regrets her limited output of poetry, fiction and ephemeral literature. Colonel Fuller is captivated by her charms, contrasting her favourably with her brothers, who appeared to him "gross, ill-mannered, and in their straw hats and trouser belts more or less offensive to the eye."

The question obtrudes—How will it all end? It would be unfair to the authors to reveal their conclusions. Both recognise that something will happen some day when America is disillusioned about the power of money and the booster's curve approaches horizontality, its tangent vanishing like the Cheshire cat. The fate of Rome is not reserved for America, for the simple reason that there are no barbarians to rush in and submerge the American counting house and lobster palace "in one red burial blent." Authors who attempt to foretell the future of America in a hundred years are on safer ground than men of science who predict the position of an unknown planet or the properties of an undiscovered element. Their work should be encouraged, for the national tendencies which they explore have their bearing on our daily life. Possibly the jazz music wafted across the Atlantic sounds a clarion bugle-call if we would listen and interpret.

T. LL. H.

Colloid Chemistry.

(1) *Das kolloide Gold.* Von R. Zsigmondy und P. A. Thiessen. (Kolloidforschung in Einzeldarstellungen, Band 1.) Pp. x + 229. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1925.) 14 gold marks.

(2) *Das kolloide Gold in Biologie und Medizin: die Goldsolreaktion in Liquor Cerebrospinalis.* Von Dr. Ernst Joel. (Kolloidforschung in Einzeldarstellungen, Band 2.) Pp. viii + 115. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1925.) 7·50 gold marks.

(3) *Einführung in die Chemie der polymeren Kohlenhydrate: ein Grundriss der Chemie, der Stärke, des Glykogens, der Zellulose und anderer Polysaccharide.* Von Prof. P. Karrer. (Kolloidforschung in Einzeldarstellungen, Band 3.) Pp. ix + 295. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1925.) 7·50 gold marks.

(1) THIS is the first of a new series of monographs on colloid chemistry, and the preface, signed by Prof. Zsigmondy alone, serves as a general introduction of the enterprise. The distinguished author deals somewhat severely with certain tendencies which

he discerns in the rapid development of the discipline during the last twenty years; the failure of authors to maintain the standard expected from workers in the field of exact science; a preference for philosophical treatment and undue generalisation; neglect of the chemical nature of the systems investigated, and other shortcomings. Against these has to be set much exact work carried out by isolated investigators, and the object of the series is to collect and co-ordinate such work and to make it generally accessible.

The first volume may certainly be said to have achieved this object; it contains everything worth knowing about gold sols. The methods of preparing them, which are due to the author, are described in every detail, and the necessity of strict adherence to these directions is duly emphasised. Their electrical and optical properties are then treated exhaustively, as well as a number of phenomena which, while not specific to gold sols, have been largely studied on this material; such are coagulation velocity and protection. The chemical composition of the sols is also discussed at length, and the author produces ample evidence to show that stable sols need not contain oxygen; a result which contradicts the view held—at least at one time—by Pauli and his school, that 'aurate' complexes impart the negative charge to the gold particles.

The volume illustrates the important part played by the study of gold sols in the development of modern colloid physics and chemistry. That this study leaves untouched some of the most important and difficult problems in this field, such as viscosity and solvation, is worth pointing out to students who are invariably attracted by the ease with which gold sols—of sorts—can be made and by their somewhat spectacular properties.

(2) Dr. Ernst Joel's volume deals with a highly specialised application of gold sol: the Lange method of diagnosing luetic and meningitic infection in the cerebro-spinal fluid. The protective effects of these morbid fluids differ from that of the normal and from one another, so that they can be distinguished by coagulating gold sol with sodium chloride in the presence of the fluid, of course in strictly defined ratios and conditions. By way of introduction the author gives a lucid and detailed account of the phenomena of protection by proteins and protein mixtures, and of the related phenomenon of sensitisation of these bodies. Critical application of this vast and difficult evidence to the Lange reaction seems to lead to the conclusion that the essence of the difference in the three types of fluid is a shifting of the albumin-globulin ratio.

(3) Although the eminently colloidal character of the polymerised carbohydrates has never been in doubt, their systematic study by modern methods has, until recently, lagged far behind that of the proteins. Some impetus has no doubt been given to it during the last decade by the enormously increased importance of cellulose and its esters in the arts of peace and war. The volume under review deals very exhaustively with starch, glycogen and cellulose; other carbohydrates receive briefer but adequate mention. The point of view is largely that of the organic chemist, structural formulæ being discussed at great length; the aspects which particularly interest the colloid chemist, such as apparent molecular or 'micellar' weights, are, however, not neglected. He will, at any rate, find here ample information regarding the chemical character of his materials which will enable him to approach one of the great tasks of the future—the co-ordination of colloidal properties with chemical constitution.

All three volumes are excellently printed and well bound, and the student of colloids who wishes to keep his library complete will have to face the purchase of these and of subsequent monographs in the series.

Aspects of the Oceans.

A Study of the Oceans. By Prof. James Johnstone. Pp. viii+215. (London: Edward Arnold and Co., 1926.) 10*s.* 6*d.* net.

LIVERPOOL is distinguished amongst British universities by the possession of a chair of oceanography from which Prof. Johnstone speaks as an exponent of the science. The subject naturally appeals most strongly to a seafaring people in those practical aspects which affect navigation, cable-laying, fisheries and the like; but Prof. Johnstone very wisely takes a wider view in opening out vistas of geological evolution and historical discovery. These considerations, rightly balanced, should serve to place the subject on a wide academic basis. The exact purpose of the book before us is not stated, but the seven chapters read like a series of semi-popular lectures each so far complete in itself as to involve a certain amount of repetition, not unhelpful to students though detracting in some degree from the close-knit unity which one looks for in a scientific treatise.

The elements of the book are rather difficult to blend. The first chapter deals with an advanced modern problem, the geological history of the oceans, and the next two with the speculations of the ancient Greeks and the history of nautical discovery since the time when the Mediterranean was 'The Great Sea.' The four remaining chapters deal from both points of view with the circumpolar regions, the Atlantic, the Pacific and the Indian Oceans respectively. The difficulty of

developing such a plan is obvious. It might have furnished a satisfactory course of University Extension lectures delivered with the animation of an enthusiast to an eager audience, and some passages (*e.g.* p. 122) suggest that, like Huxley's "Physiography," the book owes its literary form to notes taken from extempore speaking. If, however, the object was not to stimulate general interest but to guide serious study, a more systematic treatment and more sedulous revision would have done fuller justice to the author's wide knowledge.

No one can bring a great subject within the compass of a small book without leaving out much which is really of importance. Hence an author should not be taxed with omissions which he probably recognises and regrets; still, it is surprising to find that even so brief a history of the oceans as this could be written without mentioning the name of Maury. The publication of Maury's "Physical Geography of the Sea," in 1855, seems to many of us to have been the launch of the modern science of oceanography, and the memory of the great American sailor deserves to be kept alive.

I confess that I do not know enough of geology or ancient history to pass an opinion on the exposition of these subjects, but I do venture to question Prof. Johnstone's subdivision of the oceanic depression (p. 11) into *Continental Shelf* and *Ocean Bed* with the boundary between the two taken as the line of 1000 fathoms. If room could have been found for a notice of the hypsographic curve, the advantage of a more detailed subdivision of the ocean floor and slopes would probably be recognised. Even granting that the 1000 fathom isobath is to be taken as a physical boundary, it is unfair to give to the region on its landward side the name of the Continental Shelf. Most other oceanographers have accepted that term as meaning the gently sloping zone covered by shallow water extending from low-water mark to a depth of about 100 fathoms, or in rare cases, as on the Antarctic coasts, to 200 or 300 fathoms. It corresponds to the old nautical 'in soundings,' and at its deeper end there is always a sudden increase in the gradient of the Continental Slope which leads to the ocean depths. When I introduced the term in 1888, I was impressed by the wide flat expanse of the Vidal Bank west of Scotland, and recognised that it was not a local but a world-wide feature of the transitional area between land and the deep sea. Prof. Johnstone has no doubt excellent reasons for departing from the international nomenclature settled for the great Monaco bathymetrical chart, and he may have stated them in some work with which I am not familiar. It would, however, have saved confusion and perhaps perplexity if he had chosen for this zone covered with water from 0 to 1000 fathoms deep, a name which was not already in use for a definite and restricted portion of the area which he includes within it.

The book has the advantage of a good index and a brief bibliography, which might well have been supplemented by reference to the foreign literature of the subject.

HUGH ROBERT MILL.

Our Bookshelf.

Ancient Greece at Work: an Economic History of Greece from the Homeric Period to the Roman Conquest. By Prof. Gustave Glotz. Translated by M. R. Dobie. (The History of Civilisation Series.) Pp. xii+402. (London: Kegan Paul and Co., Ltd.; New York: Alfred A. Knopf, 1926.) 16*s.* net.

IN "Ægean Civilisation," a previous volume in this series, Prof. Glotz traced Mediterranean culture from its beginnings to its culmination in Minoan Crete and its decline on the mainland. To present as complete a picture as possible he sketched such an outline of the social organisation of these early periods as may be deduced from archæological remains, eked out with evidence from other sources. In the present volume he takes up the social and economic story of Greece at the point where the previous volume ended. Beginning with the pastoral society of Homeric times, he traces the development of social and economic organisation through the archaic period, the predominance of Athens, and Hellenistic times. Each period has its peculiar characteristic and, as he points out, no general statement is applicable to Greek economics as a whole, but only with special reference to some one of these periods.

Those who are not already familiar with the data will probably be surprised at the amount of information Prof. Glotz has been able to gather together relating to the early Homeric period. The manner in which he extracts his material from incidental references and allusions in the Iliad and Odyssey commands our sincere admiration. At the same time, his deductions are capable of being checked by comparison with what we know of pastoral societies elsewhere which are organised in groups similar to the Greek *gene.* The archaic period, notwithstanding that evidence of a more direct character is available, is really more obscure. The treatment of the period of the Athenian hegemony is illuminating. It is, of course, recognised that slavery is the essential factor in the social and economic organisation, but it is especially in relation to the position of the metics that Prof. Glotz is most suggestive. Is it not possible that the influence of this element in the population in the subsequent development of the characteristics of the Greek people has been underrated?

The Chemistry of Drying Oils. By Dr. R. S. Morrell and H. R. Wood. (Oil and Colour Chemistry Monographs.) Pp. 224. (London: Ernest Benn, Ltd., 1925.) 21*s.* net.

CHEMICAL industry has become so highly specialised that at the present day it is practically impossible for one person to write from first-hand knowledge a trustworthy text completely covering even one industry. It is only by a series of monographs continually being

brought up-to-date and written by experts with direct knowledge of particular processes that detailed information of real value can be secured. Under the editorship of Dr. Morrell we have an example of such a series of monographs for the oil and colour industry of which the volume under notice forms a part.

The expression and extraction of linseed and other less known oils from their seeds, the refining and bleaching of these oils as well as the preparation of boiled, blown and stand oils, receive detailed treatment. The use of these oils in the manufacture of linoleum and patent leather and the employment of drying oils as electrical insulators receive detailed consideration. The aim has been to give a trustworthy account of the most recent information regarding various processes and methods, with a critical survey of the literature by works' experts. Notwithstanding the bias towards the industrial aspect, stress has been laid by the authors on the importance of physical properties in relation to chemical changes. The composition of drying oils and their component acids, with the chemical changes occurring on drying, have been exhaustively treated before discussing manufacturing details. A valuable addition is the good list of references at the end of each chapter.

The book is excellently produced, and in fact for a monograph that will require frequent editions to keep abreast of practice, the finish is, if anything, too durable. The high price of this book, with only 200 pages of text, makes such a remark pertinent. J. REILLY.

Three Men Discuss Relativity. By J. W. N. Sullivan. Pp. xxx+233. (London and Glasgow: W. Collins, Sons and Co., Ltd., 1925.) 7*s.* 6*d.* net.

MR. SULLIVAN has achieved something new in the exposition of relativity by writing in dialogue form. One is inevitably reminded of Galileo, but in Mr. Sullivan's book, unlike that of the great Florentine, the characters are not provided with conflicting preconceptions. They are, in fact, not private individuals so much as actors whose parts are made to fit together in such a way as to provide a smooth, uninterrupted account of the theory for the reader. After a brief introduction, six dialogues are set forth, between a mathematical physicist, a philosopher, and an ordinary intelligent person. The mathematical physicist has undertaken to expound the theory of relativity to his companions, who make just the right remarks or ask appropriate questions at frequent intervals. It must be confessed that the ordinary intelligent person is much more intelligent than the sort of person one ordinarily meets with.

From an artistic point of view, the dialogue method as here employed can scarcely be regarded as successful. It does, however, add considerably to the interest of the exposition, and is on that ground justified. The mathematical detail of the subject is almost completely excluded from the dialogues and given in a 45-page summary at the end. Those who wish to obtain an accurate idea of relativity in rather more than its outline and are prepared to expend some mental effort, can do no better than read this agreeable and well-produced volume. "My own indebtedness," writes the author, "is chiefly to Prof. Eddington's 'Mathematical Theory of Relativity.' It is easily the best exposition I have read, and I have adhered to it almost slavishly in the following pages." It will be gathered that the treatment is not wholly original, but the book is not a superfluous paraphrase of Eddington's work.

The Geology of the Netherlands East Indies: Lectures delivered as Exchange-Professor at the University of Michigan in 1921–1922. By Prof. H. Albert Brouwer. Recorded and prepared by Laurence M. Gould. (University of Michigan Studies, Scientific Series, Vol. 3.) Pp. xii+160+18 plates. (New York: The Macmillan Co., 1925.) 3 dollars.

THE thanks of all students of geology are due to Prof. Brouwer and to the University of Michigan authorities for this very readable and well-illustrated digest of our present knowledge of East Indian geology; the more so because a large proportion of the extensive literature published on the subject during the last few years has appeared in Dutch.

Of especial interest are those chapters dealing with the tectonic and volcanic features of the region, and their bearing on modern theories of Alpine structure. The author explains how the configuration of a large part of the Archipelago—in particular the two festoons of islands which surround the Banda Sea—is a direct expression of mountain-building processes still in operation. The foreland is formed by the Australian continent and the bordering Sunda shelf; the rising festoons are actual geanticlines, and the deep, elongated sea-basins between them true geosynclines; the younger arc (the inner one) is characterised by active volcanicity, which is absent in the older one. If the compressive forces now in operation persist, a continental mountain range of the Alpine type may ultimately develop.

Higher Mathematics: for Students of Engineering and Science. By Frederick G. W. Brown. Pp. xii+488. (London: Macmillan and Co., Ltd., 1926.) 10*s.*

THIS work embodies those branches of pure mathematics required by senior engineering students up to degree standard and it covers the field very adequately. There are chapters on determinants, spherical trigonometry, several chapters on differentiation and integration and ordinary differential equations up to simultaneous systems, plane curves and three dimensional geometry. For an attempt to return from the monograph to the 'comprehensive' type of book it is eminently successful, and the numerous examples are well chosen with the correct practical bias. The theoretical parts are weaker in presentation than the practical portion, but not sufficient to vitiate a really useful book.

Wolfram: Fortschritte in der Herstellung und Anwendung in den letzten Jahren. Von Dr. Hans Alterthum. (Sammlung Vieweg, Heft 77.) Pp. viii+111. (Braunschweig: Friedr. Vieweg und Sohn A.-G., 1925.) 4·50 gold marks.

THIS useful monograph contains an account of the newer researches on tungsten, its alloys and more important compounds, made since 1910, and is not a complete account of the subject. The localities of the occurrence of tungsten ores, the preparation of tungsten and the physical properties of the metal, together with analytical information and some account of the compounds, are dealt with. There is no index.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Solidification of Helium.

ON June 25 helium was compressed in a narrow brass tube forming communication between two German silver tubes. The brass tube and part of the two German silver tubes were in a liquid helium bath. At a pressure of 130 atmospheres the tube system appeared to be blocked. When the pressure was diminished by 1 or 2 atmospheres the tube system was open. The temperature of this experiment was somewhat uncertain. By diminishing the pressure of the liquid helium bath the same phenomenon was observed at a temperature of about 3·2° K. at 86 atmos., and at a temperature of about 2·2° K. at 50 atmos. From the regularity of the phenomenon it appears that we were observing the solidification curve of helium. This method of observing solidification has indeed already been used by Kamerlingh Onnes and Van Gulik in preliminary measurements on the curve of solidification of hydrogen.

A repetition of the experiment on July 1 confirmed the early observations. At 4·2° K. helium solidified at 140 atmos. The solidification curve was prolonged to 1·1° K., and the helium solidified then at 26 atmos. The exact numerical data will be given elsewhere. The solidification curve bends so that at the lower temperatures it shows a tendency to become parallel to the axis of the temperatures. So far as can be ascertained from these observations, helium is expected not to have a solid-liquid-gas triple point.

Finally, helium was compressed in a glass tube provided with a magnetic stirrer after the pattern of Kuenen. The observations on the solidification of helium were confirmed. The stirrer was seen to stick when the helium solidified. In one experiment part of the substance was liquid and part solid. One could hammer the solid block with the stirrer that was in the liquid part. A limiting surface between the solid and the liquid could not, however, be seen. Solid helium forms a homogeneous transparent mass, the refractive index of which probably differs extremely little from that of the liquid.

W. H. KEESOM.

University of Leyden.

Supplementary Note on Radiation.

PERMIT me to make a little correction to my letter on page 801 (June 26) about the law of radiation. It is usual to quote Rayleigh's law in the form there given, namely, $8\pi RT\lambda^{-4}$; the $8\pi R$ part is, however, due not to Rayleigh but to Dr. Jeans (see *Phil. Mag.* for July 1905). In Rayleigh's 1900 paper he left the constant undetermined. Afterwards, in NATURE for May 18, 1905, he concluded, from simple gas-theory, that the constant would be $64\pi R$; but Jeans speedily pointed out a source of error, and made the constant $8\pi R$, a correction which Rayleigh at once accepted (see his "Collected Works," vol. 5, p. 253; also p. 248).

It is interesting to note that had the possible modes of vibration been one-dimensional, as in sound, the numerical part would have been 4π; in light the transverse vibrations have two modes open to them. This makes the constant 8π; while if, as in an elastic solid, vibrations had been possible in all three directions of space, the constant would have been 12π (see Jeans's "Report," p. 14). In no case could it be 64π; but that was a slip, due to counting some integers twice over.

Another point in which my letter might be misleading is that the dynamical proof of the continuous-spectrum law of radiation had given no indication that the result would only be true for long waves. It must have been clear by common sense that it did not hold for short waves, but no reason for this was suggested by orthodox dynamics. The serious discrepancy remained a puzzle, until it was solved by the quantum.

In other words, as I express it, neither gas-theory, probability, nor dynamics was competent to express fully the interaction between matter and ether. An expression obtained by attending to continuous equipartition of energy in matter alone, was bound to be incomplete; while if the doctrine of continuous equipartition was extended to the ether, with its apparently unlimited degrees of freedom, the result was impossible. Indeed, thirty years previously, Maxwell had emphasised this outstanding difficulty of molecular theory, in his lecture on the "Molecular Constitution of Bodies," reported in NATURE, vol. 11, pp. 375-6 (or "Scientific Papers," vol. 2, pp. 433-438), and had decided that whatever the constitution of the ether might be it could not be molecular. Discontinuous partition, as represented, by the quantum, enabled the true radiation law to be obtained; and the puzzle was thereby shifted to an explanation of the quantum itself—a problem which can scarcely be solved until we possess more knowledge about the intimate structure of the ether.

OLIVER LODGE.

Prof. Miller's Ether Drift Experiments.

THROUGH the courtesy of Prof. Miller I have been made acquainted with the results of his February series of observations made on Mt. Wilson, to be published in the *Proc. Nat. Acad. Sci.*, Washington. I am sorry to say that my opinion concerning the significance of the observed displacements disagrees with his so completely that I cannot attribute the effect to any cosmic cause.

The calculations of Prof. Miller and his collaborators lead to the conclusion that an ether drift directed towards a point in the constellation Draco (R.A. 17 h., Decl. +68°) would agree best with the observed effects. The drift is assumed to be caused by a motion of the solar system towards the given direction with a velocity of approximately 200 km./sec. A partial drag of the ether is supposed to reduce this velocity to 10 km./sec. at the surface of the earth, thereby annulling the influence of the orbital motion.

My objections against these assumptions are laid down in a paper published recently in the *Zeitschrift fur Physik* (vol. 35, p. 723, 1926). The theoretical curves of the line displacements as plotted against the azimuth of the apparatus are given there for different directions of the ether drift. A comparison with the mean value of Prof. Miller's observations shows systematic deviations as large as the full amount of the effect occurring at certain hours of the day. The asserted good agreement between the assumed ether drift and the observations is due to the fact that Prof. Miller has arbitrarily displaced the theoretical curves, giving the azimuth of drift as a function of sidereal time to match the empirical curves. This procedure may be justified in all cases where only the *shape* of the curves is essential. In the present case, however, the absolute values of the curves play a fundamental rôle.

As Prof. Miller rightly remarks, the projection of a

fixed direction in space on the horizontal plane ought to move equally to the east and to the west during a sidereal day. What actually happens is the occurrence of an effect pointing towards the north-west quadrant of the compass in about ninety-five per cent. of all observations. This fact seems to be fatal to the assumption of an ether drift of constant direction towards a certain point of the heavens. If the effect were really genuine it would prove the existence of a north-west drift of the ether accompanying the earth's rotation. The velocity of the drift would be at least 10 km./sec., whereas the velocity of the daily motion of a point of the equator is only about five per cent. of this amount. The advocates of the ether will find it difficult to account for a whirling motion of the ether round the earth with a velocity surpassing that of the earth's rotational motion about twenty times.

Apart from the systematic deviations, there are large irregular discrepancies in the observations. The mean value of the ether velocity at a certain hour of the sidereal day taken from twenty single observations differs sometimes by more than 100 per cent. from the total average for the same hour taken from all observations of a given epoch.

It appears that on account of the extreme difficulties of the measurements, which were vividly described in Prof. Miller's presidential address before the Kansas Meeting of the American Physical Society, the results of the Michelson experiments are less trustworthy and less stringent than they have been supposed to be. The Trouton Noble experiment offers considerably less difficulty, and its negative result may be regarded as more convincing. Dr. R. Tomaschek, of the University of Heidelberg, has repeated this experiment at an altitude of 11,400 ft. at the Jungfraujoch, Switzerland (*Ann. d. Phys.*, vol. 78, p. 743, 1926). The observed effects did not exceed the errors of observation, and it was concluded that there is no relative velocity of the ether greater than 3 km./sec. at the given altitude.

This result gives rise to doubts concerning the significance of the interference shifts observed at Mt. Wilson. The doubts are augmented by the great irregularity of the measured shifts and by the predominance of the north-western direction in the diurnal variation of the effect, which is inconsistent with the assumption of an ether drift of constant 'absolute' direction.

My conclusion is, therefore, that the effect must not be attributed to any cosmic cause at all, but may be due to local disturbances.

HANS THIRRING.

Institut für theoretische Physik,
Universität, Wien,
June 19.

The Molecular Spectrum of Carbon Dioxide.

THE value of the specific heat of carbon dioxide indicates a triangular molecule. Bjerrum (*Deutsch. Phys. Ges.*, **16**, 737, 1914) has made a study of this molecule and has decided that the atomic nuclei lie at the corners of an isosceles triangle the apex angle of which is either 145° or 40°·6. Dennison (*Phil. Mag.* (7), 1, 195, 1926) decides in favour of the former angle. Such a model, according to these authors, should be characterised by three fundamental vibrational frequencies. Each tries to associate the three well-known bands of absorption at 14·66μ, 4·25μ and 2·73μ with these predicted frequencies. The model does not anticipate a fourth weak band which I found at 2·02μ (*Phys. Rev.*, **26**, 469, 1925), especially since this is not harmonic with any of the other three.

Dennison associates the 4·25μ band with a motion of the carbon nucleus perpendicular to the bisector of the apex angle, and the other two bands with motions of the oxygen nuclei along the line joining them, the carbon nucleus moving along the bisecting line in such a way as to keep the same molecular configuration. In attempting to identify the observed relative intensities of these three bands with his predicted amounts, he meets with success in the case of the two longer wave-lengths but fails in the case of the third one. For whereas this band should be only 1/180th so intense as either of the other two, it actually is found to have 1/4th their intensity.

A new explanation for the presence of the 2·73μ band as well as of the weaker 2·02μ band has been sought on the basis of combinations of the frequencies of the strongest two bands. Table I. shows that the frequencies of the two weaker bands are approximately equal to $\nu_a' + 2\nu_a$ and $\nu_a' + 4\nu_a$ respectively, where ν_a' and ν_a are the frequencies of the 4·25μ and 14·66μ bands.

TABLE I.

ABSORPTION BANDS OF CARBON DIOXIDE.

		Designation	Calc.	Diff. Per cent.
14·66	68·9			
4·25	235·5			
2·73	366·3	$\nu_a' + 2\nu_a$	373·3	1·9
2·02	495·0	$\nu_a' + 4\nu_a$	511·1	3·2

Emission bands corresponding to each of the carbon dioxide absorption bands, including the newly observed weak one at 2·02μ, have been found in the spectrum of the Bunsen flame. Table II. shows the values of these bands, as well as the agreement of the frequencies of the weakest two with values calculated on the basis of combinations similar to those of Table I.

TABLE II.

EMISSION BANDS OF CARBON DIOXIDE.

λ in μ.	ν in mm.$^{-1}$.	Designation	Calc.	Diff. Per cent.
14·1	70·8	ν_e		
4·4	227·0	ν_e'		
2·76	362·0	$\nu_e' + 2\nu_e$	368·6	1·8
1·99	502·0	$\nu_e' + 4\nu_e$	510·2	1·6

It will be noticed that in every case the calculated combination frequenoies are somewhat larger than the observed values. This should be anticipated if we are to associate the terms $2\nu_a$, $4\nu_a$, etc., with approximate harmonic vibrations of some portion of the molecule; for the so-called harmonic vibrations arise from causes which also produce deviations from true overtone relationships, namely, the non-linearity of the force and the finite amplitudes of motion of the nuclei. Thus in the case of hydrogen chloride the first harmonic absorption frequency differs by 1·7 per cent. from a true multiple relationship (Brinsmade and Kemble, *Proc. Nat. Acad. Sci.*, **3**, 420, 1917), while extrapolation of the frequencies which I have observed to be characteristic of the C-H bond in all organic substances (*Phys. Rev.*, **27**, 298, 1926) indicates a corresponding deviation of 1·85 per cent.

Comparison of the above data shows an increase in frequency in the case of the longest wave-length band in passing from absorption to emission, while an opposite change characterises the 4·25μ band.

This in itself suggests separate origins of the two frequencies within the molecule. Furthermore, it suggests a strengthening of one type of bond and a weakening of the other type when the molecule is subjected to the greater thermal agitation in the flame. This is indicative of a slight change in the molecular configuration.

Further support of the combination theory proposed above is the gradual predomination of the lowest characteristic vibration frequency in the combination bands. This is shown in the approach toward equality in the $2{\cdot}73\mu$, $2{\cdot}76\mu$ bands, and the greater frequency value of the emission band in the case of the $2{\cdot}02\mu$, $1{\cdot}99\mu$ band.

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Higher Order X-ray Reflections from Fatty Acids.

As is known from recent researches, especially in the Davy Faraday Laboratory, X-ray reflection from fatty acids shows the existence of a long spacing, which increases proportionally to the number of carbon atoms in the molecule. Using fatty acid crystals, we have succeeded in observing reflections up to a very high order. We were able to verify the work of Müller, Shearer and others; on the other hand, some new facts were brought to light.

Flaky crystals several millimetres square (the long spacing of which is normal to their surface), obtained by crystallising from acetone, were mounted on the calcite crystal of the X-ray spectrograph; lines due to the latter crystal served as reference lines. Iron-, copper-, and zinc-radiation was used.

As had been found by Müller and Shearer, the 1st, 3rd, 5th . . . orders of reflection from the long spacings are much stronger than the 2nd, 4th, . . . orders. Shearer has shown that this feature may easily be understood by assuming a simple model for the scattering power [1] of the fatty acid molecule. Our photographs show some new complications for the higher orders, as may be seen from the accompanying diagram (Fig. 1). In the upper portion the observed intensities in the case of palmitic acid (C_{16}) are given. These were estimated by eye, much help for a correct estimation being afforded by the fact that $K\alpha$ and $K\beta$ lines appeared at the same time on the plates; the intensity of the $K\beta_1$ is known to be about 25 per cent. that of the $K\alpha_1$ line.

As may be seen from Fig. 1, in the neighbourhood of the 9th order, even and odd orders are about equally intense, whereas at the 16th order the even orders are by far the strongest (the 16th order is about as intense as the 5th).

This intensity-distribution may be accounted for in its main features by a little more detailed model for the scattering power of the molecule [2] than that used by Shearer. Such a model is given in the right-hand part of the figure. As in Shearer's model, two molecules are placed end to end in opposite directions. At one end of the molecule a deficit of scattering matter (CH_3 group) is found; at the other end a surplus (COOH group). Calculations based on this model give for the intensity of the rth order:

$$I_r = \left[\frac{\sin\left(\frac{r\pi}{12}\right)}{r}\right]^2 \text{ when } r \text{ is odd,}$$

$$I_r = \left[\frac{\sin\left(\frac{r\pi}{12}\right) - \sin\left(\frac{r\pi}{24}\right)}{r}\right]^2 \text{ when } r \text{ is}$$

These calculated intensities are given in the lower portion of Fig. 1. Bearing in mind that the assumed model is far too simple to express the real state of things, and that, in addition, no correction was applied to the observed intensities, the agreement between calculated and observed values must be called very satisfactory.

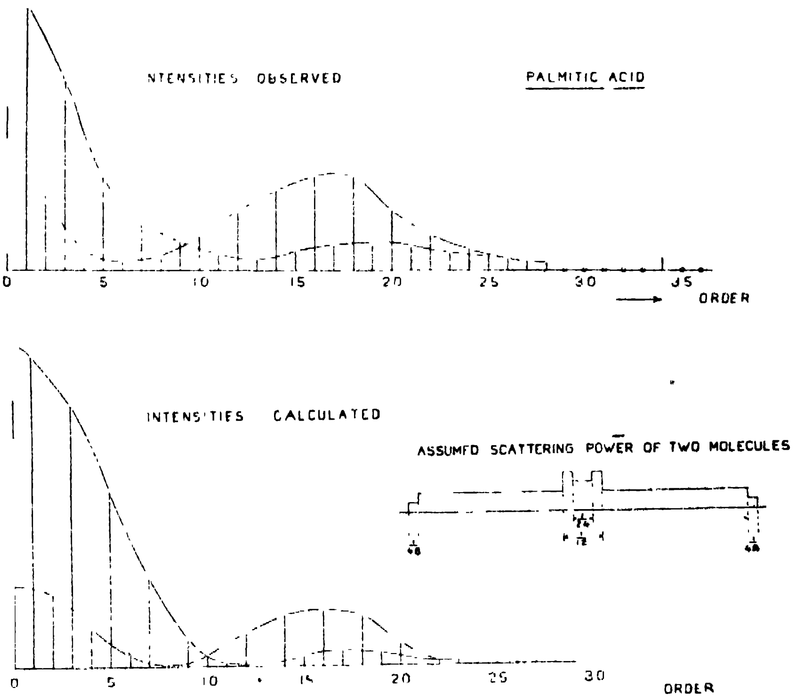

FIG. 1.

Similar results were obtained with lauric (C_{12}) and stearic (C_{18}) acids. In the first case a maximum of intensity for the even orders occurs at the 12-14th order; in the second case, at the 18-20th. In these cases the observed intensities may be accounted for by similar models for the molecules with the same dimensions of COOH and CH_3 group.

A very remarkable fact has been revealed in the case of palmitic and lauric acids The 34th order of palmitic acid (see Fig. 1) appeared distinctly in four hours on our photographs, whereas other orders higher than the 28th could not be detected even with exposures varying from six to eight hours (such orders sought for but not observed are indicated in the figure by small circles). In the same way the 26th order of lauric acid was clearly visible, no other orders higher than the 21st being detectable. In the case of stearic acid, our crystals were

[1] In this case the scattering power may be assumed proportional to the number of electrons belonging to the different atoms in the molecule.

[2] Strictly speaking, the distribution of scattering matter in planes normal to the long spacing governs the intensities of the different orders, but in this and similar cases this distribution is intimately related to the structure of the molecule; most probably the molecules are inclined at a definite angle to these planes.

unfortunately not good enough to go on to the corresponding (38th) order.

We are inclined to conclude that this singularity of the 34th order of palmitic and 26th of lauric acids depends upon the fact that the scattering matter is not uniformly distributed along the chain of the molecule, but contains a periodicity due to the successive CH_2 groups. The following facts seem to support this view. For twice the long spacing of palmitic acid we found 71·20 Å.U., and in the case of lauric acid, 54·45 Å.U. This means an increase per single CH_2 group of 1·045 Å.U. If we may assume this to be the mean distance of successive CH_2 groups, the double molecule of palmitic acid would be to a very high approximation 34 times this distance, and that of lauric acid 26 times.

The investigations are being continued with other chemical compounds

Our samples of fatty acids were furnished by the kindness of Dr. Treub, chemist at the Kon. Stearine-kaarsenfabrieken at Gouda.

J. A. PRINS.
D. COSTER.

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Transmutation Experiments.

SINCE so large a proportion of the discussion relating to the reported transmutation of mercury into gold has been carried on in the columns of NATURE, it may be of interest to communicate briefly the results of experiments which have been in progress for some time in this laboratory, fuller details of which will be published shortly.

Various experimental arrangements were employed, but in no case has it been possible to establish the production of gold from the mercury. In the earlier experiments a condensed discharge, at a peak voltage of 15,000, was passed (*a*) between tungsten electrodes immersed in a fine emulsion of mercury droplets in white paraffin oil, (*b*) between aluminium rods in an emulsion of mercury in distilled water, and (*c*) between an iron pole and a mercury surface in an atmosphere of hydrogen. Secondary currents up to 75 ma. were passed for as long as twelve hours, but with uniformly negative results.

The most decisive experiment, however, was one which was designed to reproduce as nearly as possible the electrical conditions obtaining in Miethe's experiments with the rotating mercury interrupter, while reducing to a minimum the very grave danger of contaminating the mercury by contact with foreign substances. The mercury was sealed up in an atmosphere of hydrogen in a small quartz tube attached to a shaking machine, so that an arc was formed between pure mercury poles and drawn out to extinction six or eight times per second. A 30-ampere arc at 100 volts was run for 144 hours, followed by an 18-ampere arc at 240 volts for an equal period. During the last 24 hours of this run the tube was made to function as the interrupter for an induction coil, the secondary of which maintained a condensed spark discharge in air. Only 18 gm. of mercury was employed, and this remained perfectly bright and uncontaminated to the last. It was dissolved up at once in nitric acid, without being subjected to distillation, and a direct simultaneous determination proved that 10^{-8} gm. of gold could have been detected with certainty under the conditions of the experiment. No trace of gold was found.

The most conservative calculation based on the results of Miethe (*Zeitschrift f. anorg. Ch.*, **150**, 350, 1926) leads to an expected yield of 0·11 mgm. of gold, or at least 10^4 times the quantity which could not have escaped detection had it been present. Since the electrical conditions were identical in all essential respects with those in Miethe's experiments, it seems necessary to conclude, with Haber (*Naturwissenschaften*, May 7, 1926; NATURE, May 29, 1926), that Miethe's gold was derived from the materials of his electrodes and his vessels.

The mercury used in these experiments had been twice distilled, below 200° C., at the rate of about 100 gm. per hour, in mercury stills of quite ordinary design, and in no single instance could any trace of gold be recovered from the distilled mercury. The writer shares Miethe's opinion that the contrary results of other investigators have been due to mechanical carrying over of the amalgam, rather than to a true distillation of the gold.

An attempt to prepare indium from tin, by a similar method, also failed, though the spectroscopic method of detection was so delicate that great difficulty was experienced in obtaining indium-free tin for the experiments. A further attempt to produce scandium from titanium by electronic bombardment in an X-ray bulb proved equally unsuccessful.

Experiments are in progress upon the reported transmutation of lead into thallium and mercury. Obviously, no artificial production of such a common element as mercury can be regarded as established without the greatest rigour of proof that every possible source of contamination has been eliminated. The difficulty of completely excluding mercury has been well shown by its frequent appearance in the spectrum from the tin tubes, in which it was hoped to produce indium.

MILAN W. GARRETT.

Clarendon Laboratory,
Oxford,
June 25.

The New Element of Atomic Number 61: Illinium.

IN their interesting note on the discovery of illinium (NATURE, June 5, p. 792) upon which the authors, Messrs. Harris, Yntema, and Prof. Hopkins, may be congratulated, I find the statement that "there were no theoretical grounds for supposing that eka-neodymium [sic!] might exist until Moseley's rule showed that element number 61 was still to be identified." Having devoted almost all my scientific life—since 1877—to the theoretical and practical study of the elements of the rare earths, and especially to the question regarding their position in Mendeléeff's periodic system (the object was not very popular forty-eight years ago!), one of the results of which was the decomposition of the old didymium in 1882, I arrived at the conviction that the gap between the neodymium and samarium was abnormally large. In my paper read before the Bohemian Academy and the Russian Association of Scientists in St. Petersburg in 1902, I came to the conclusion—not reached by any chemist before—that the following seven elements, possessing now the atomic numbers 43, 61, 72, 75, 85, 87, and 89, remained to be discovered. As regards element No. 61, the difference between the atomic weights of Sm - Nd = 6·1, and it is greater than that between any other two neighbouring elements. It is remarkable that it is of the same order as that between the atomic weights of Mo - Ru = 5·7, between which stands ekamanganese, and of Os - W = 6·9, between which stands dwimanganese, recently discovered in our laboratory by Heyrovský and Dolejšek.

Personal knowledge of the chemistry of neodymium—the spectrum (absorption) I thought too complicated—and samarium brought me to the conclusion that also between those two elements an unknown element was missing, but all investigation by old methods was fruitless. Another reason may also be of interest. On arranging the true hydrides (in which the hydrogen is negative towards the positive metal) of the elements of the 8th series of the periodic system according to the order of their atomic weights, we find the following remarkable regularity of the composition of those peculiar compounds:

$$CsH_1, BaH_2, LaH_3, CH_4, PrH_3, NdH_2, (XH_1), SmH_0.$$

As samarium does not combine with hydrogen (Muthmann) there must exist between neodymium and samarium an unknown element which forms the hydride XH—*and this element is illinium.* My speculation has not proved futile.

BOHUSLAV BRAUNER.

Bohemian University,
Prague, June 12.

Identity of *Herpetomonas papatasii* and *Leishmania tropica*.

THREE successful experiments have been recorded by us in which cutaneous leishmaniasis was transmitted to man by inoculation of *Herpetomonas papatasii* from naturally infected sandflies (*Phlebotomus papatasii* ♀♀) (*Annals of Trop. Med. and Parasitol.*, vol. 20, No 2). Noguchi ("Action of Certain Biological Chemical and Physical Agents upon Cultures of Leishmania; Some Observations on Plant and Insect Herpetomonads." International Conference on Health Problems in Tropical America, 1924) and Kligler ("The Cultural and Serological Relationship of Leishmania." *Transact. Roy. Soc. Trop. Med. and Hyg.*, vol. 19, Nos 5 and 6, 1926) have introduced methods of preparing immune sera and distinguishing *Leishmania tropica*, *L. donovani*, and *L. braziliense* by agglutination. Agglutination and cross agglutination experiments with cultures from the three experimental lesions and three strains from naturally acquired lesions (two from Palestine and one from Baghdad) definitely proved the identity of the organisms from the experimental lesions with *Leishmania tropica*. *Herpetomonas papatasii* is, therefore, a synonym of *Leishmania tropica*, and the fact that *Phlebotomus papatasii* is a natural transmitter of cutaneous leishmaniasis is completely established, since in addition to the evidence of experimental transmission the Herpetomonas naturally occurring in the above insect is shown to be biologically identical with *Leishmania tropica*.

We hope to publish shortly complete details of our experiments elsewhere.

S. ADLER.
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Pernicious Grafting.

THE Madeira agriculturist will be glad of any enlightenment on a devitalising influence frequently experienced in grafting a vigorous wild peach or nectarine seedling with a scion from a cultivated example. The wild seedling germinates from any chance seedstone thrown upon our terraces and develops rapidly into a sturdy tree, almost evergreen in character, crowded in the late autumn with a wealth of fascinating flower before the deciduous annual iage has left the branches bare, and yieldi early spring onwards an overwhelming crop of disappointing fruit.

If such a stock is cut across and grafted from a more worthy example in February, organic union is perfectly established and the new grafts speedily develop into sturdy ligneous growth which, by November, exhibits a promise of the vigorous output of leaf and flower customary in the wild seedling. But something now happens, and the tree, paralysed or devitalised, passes through the winter and spring months without a single leaf- or flower-bud breaking forth into activity.

Vitality is entirely suspended, and the tree is apparently poisoned by the introduction of an incompatible sap, although a modified life or mere existence may endure indefinitely. The removal of the intrusive grafts is unavailing, for the condition is all-pervading and not one of local obstruction.

Madeira is scarcely four days distant from the London markets, and it is of economic and commercial importance to remove any impediment to the almost perennial output of our sun-ripened produce.

MICHAEL GRABHAM.

Madeira, June 24.

Organo-Metallic Compounds.

AN X-ray investigation of the structure of the series of compounds carbon-, silicon-, germanium-, tin-, and lead-tetraphenyls, now almost completed, appears to indicate an interesting field of research in the organo-metallic compounds. It is proposed to extend the work to other series of these compounds so that after a time a systematic study may be made of the effects of varying (i.) the element, and (ii.) the groups. In order that this may be attempted, the writer appeals to chemists for the loan of small quantities of any related organo-metallic compounds which may be stable solids in air at ordinary temperatures.

To give an idea of the quantity of material sufficient for this work, it may be stated that the crystal of germanium tetraphenyl kindly lent by Prof. G. T. Morgan and found to give satisfactory results measured only 1·5 mm. by $[0{\cdot}065 \text{ mm.}]^2$, whilst from 0·15 gm. of powdered tin tetraphenyl kindly lent by Mr. A. E. Goddard, Mr. W. B. Saville, who is co-operating with me in this work, was able to grow a number of crystals suitable for use on both the photographic and the ionisation X-ray spectrometers.

WM. H. GEORGE.

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Blood Reactions and Sex.

THE method elaborated by Manoilov for distinguishing the sexes has been used by us in the case of the fowl. Male can certainly be distinguished from female by this test. Seven birds which previously functioned as hens but now, having undergone complete sex-reversal, are fecund and potent cocks, all exhibit the female reaction indubitably. This being so, this test may be expected to provide valuable corroborative evidence concerning the genetic sex of certain kinds of sexually abnormal individuals.

The reaction in the case of blood from a fowl from which the gonadic tissue has been removed is, in our hands, not yet sufficiently definite.

F. A. E. CREW.

Animal Breeding Research Dept.,
University of Edinburgh.

X-Rays and Living Matter.[1]

By Prof. J. A. CROWTHER, University of Reading.

THE possible importance of X-rays in the medical world was recognised so clearly by their discoverer, Röntgen, that the first communication on the subject was made by him to a medical society, and was published to the world in a medical journal. Nor were medical men slow to appreciate the potency of the weapon which had thus been placed in their hands. The medical profession, be it spoken to its praise, has been unremitting in its search for new weapons in the fight against disease. Dr. Gilbert, himself no mean physician, and author of the first treatise on magnetism, records, with perhaps undue scorn, how, in the days when magnetism was the latest scientific marvel, patients were dosed with decoctions of lodestone as a possible panacea for all ills. It was not likely that so startling a discovery as X-rays would be overlooked, and we find medical men among the pioneers of X-ray work in nearly all countries. Further, the economically effective demand of medical radiology for more power, and still more power, has persuaded engineers and manufacturers to produce the modern high-power X-ray plant which has made possible the recent advances in the subject.

It was discovered early, but unhappily not early enough, that whatever healing power the radiation might possess, its destructive power on human tissue was indubitable and great. Few of the pioneers of radiography and radiotherapy escaped the painful and intractable X-ray burn, which arises from too prolonged an exposure to the radiation, and not a few have died as a result of the injuries thus received. Their labours have not been fruitless, and X-ray treatment is now a standard part of the work of any properly equipped hospital. At the same time one can detect to-day a certain undercurrent of dissatisfaction among radiologists. The rays have not yet fulfilled all their expectations. In particular, in some grave diseases where remarkable cures have been effected by X-ray treatment, a repetition of the same treatment in other apparently similar cases does not invariably produce the hoped-for result. There are undiscovered factors remaining to be elucidated. We need to ask how X-rays act on living matter, and in particular upon the living cell from which all living matter is built. The biologist, the physicist, and the chemist must be called in to assist, and the investigations must take in a wider sweep, before these problems can ultimately be solved. In science, as in other walks of life, it sometimes happens that the longest way round is the shortest way home.

It must not be supposed that so promising a field of research has been hitherto left uncultivated. There is, on the contrary, an overwhelming accumulation of observations and experiments. The results of different observers are, however, so conflicting that most of the evidence cancels out and leaves only a small residuum which can be said to be known with any certainty. This is scarcely surprising when we consider the conditions under which much of the work has had to be done. It is only within quite recent years that apparatus has been designed which makes it possible to repeat a given exposure with even approximate certainty, even with the same apparatus. It is not possible, even now, to give identical exposures if the apparatus is changed; if, for example, a high-tension transformer is substituted for an induction coil, or a Coolidge tube for a gas tube. Each type of apparatus for producing X-rays, one might almost say each individual set, has its own peculiarities, which are reflected in the quality and quantity of the radiation it produces. Our present state of knowledge does not allow us to assume that any of these variations have a negligible effect on the results.

Nor is there, at the present moment, any standardised or completely satisfactory method of recording these varied exposures. The properties of a given X-radiation are determined, physically, by its wave-length or frequency and its intensity. The radiation from an X-ray tube is, however, not monochromatic. It consists of a band of radiation stretching over a considerable range of wave-lengths. In optical terms, our X-ray tube gives us a continuous spectrum, which, moreover, may be crossed by intensely bright lines due to the characteristic radiation of the target from which the rays come. The band of maximum intensity moves towards the short wave-length end of the spectrum as the potential on the tube is increased, but the radiation is always mixed. In fact, for a given current, we shall get a larger absolute output of radiation of long wave-length from a tube working at high potential than from one at low potential. The distribution of energy in this complex spectrum depends on the wave-form of the high-tension apparatus used to supply the X-ray tube, and on the tube itself. If, as seems quite possible (there is ample experimental evidence both for and against the supposition), the biological effect is a function of the wave-length, it becomes a matter of considerable importance to determine not only the extreme wave-lengths but also the distribution of energy between the different wave-lengths in the radiation used. The discoveries of Prof. Laue, and their ingenious applications by Sir Wm. Bragg, have rendered this possible, but in very few researches so far conducted on the action of X-rays on living matter has any attention been paid to this important factor.

The measurement of the intensity of the radiation is a still more difficult problem, and one which cannot yet be said to have been solved by the physicist. The ideal method would be to measure the energy in the beam by absorbing it completely in some heavy metal, such as lead, and measuring the heat produced. Unfortunately, the actual energy even in a powerful beam of rays is so minute that, although it has been detected, it would strain the resources of a well-equipped physical laboratory to measure it with any accuracy. It is necessary to fall back upon some secondary property of the rays. The only secondary property which is capable of being measured with the necessary accuracy is that of producing ionisation in any gas through which it passes. Gas through which X-rays are passing becomes feebly conducting to electricity

[1] Substance of a course of two lectures delivered by the author at the Royal Institution on January 19 and 26.

and the current which can be passed across the gas is a measure of the ionisation, and thus, indirectly, of the intensity of the radiation. Prof. Friedrich has proposed that the amount of X-radiation which will allow a charge of one electrostatic unit to pass across one cubic centimetre of air shall be taken as the unit quantity of X-radiation. This proposal has met with some opposition, but personally I do not see the possibility of finding a better unit, at any rate in the immediate future. At least it may be affirmed that until experimenters can agree upon some method of measuring their quantities, progress is not likely to be rapid.

If any apology should appear to be needed for devoting so large a portion of our space to the question of measurement, it is certainly provided, not merely by the large mass of painstaking observations which have been rendered almost nugatory for want of it, but also by the records of recent work in the subject. Everything, in fact, seems to indicate that the biological effect of the rays may vary in a perfectly astounding manner with quite trifling variations in the magnitude of the exposure and the wave-length of the radiation. Only within the last few months a paper has come through from Australia, in which the author, Dr. Moppett, claims to have demonstrated a selective effect of the radiation of surprising sharpness. Dr. Moppett spread out his beam of X-rays into a spectrum, by means of a Bragg spectrometer, and exposed one of the important membranes of an ordinary chicken embryo in turn in various parts of the spectrum. He found that at certain definite positions in the spectrum, that is to say for certain definite wave-lengths of the radiation, the cells in the membrane were rapidly killed by the action of the rays, while much longer exposures to neighbouring wave-lengths produced no effect. The effective radiations had wave-lengths of 0·11, 0·53, and 0·79 Angström units. Wave-lengths differing by only a few per cent. from these values were quite inoperative.

The paper, it must be confessed, is sadly lacking in the details which a physicist requires to assess its accuracy, and in many particulars it is by no means clear. One would certainly not have expected to obtain a selective effect with radiation of so short a wave-length as 0·11 A.U., and if this result is verified we may have to revise some of our physical ideas as to the absorption of X-rays by matter. It is desirable that Dr. Moppett's work should be repeated. If, however, for the moment we accept these results, it is not difficult to point the moral. The wave-length 0·11 A.U. is somewhere near the limit of the spectrum for a hard X-ray tube. It requires for its excitation a voltage across the tube of about 120,000 volts. Suppose the experimenter to be working his tube somewhere about this voltage. A slight rise in the voltage will produce a copious supply of the deadly radiation. On the other hand, if the voltage falls by but a small amount this radiation may be absent altogether. A trifling change in the supply voltage, to which few of us would, in practice, pay any attention, may thus completely alter the nature of the results obtained.

Experiments indicate that the margin in the case of the dosage given is equally narrow. Although the effect of a prolonged exposure to X-rays is invariably lethal, small doses often produce a healthy stimulation. This has been proved, by Prof. Russ among others, in the case of rats. It is also very evident in the case of Protozoa. I have found that an old culture of *Colpidium Colpoda*, for example, may be stimulated to new growth and active division by a suitable dose of radiation. The margin between stimulation and death is a very narrow one. In fact it is possible, by a careful adjustment of the dose, to have as the result of a single exposure individual colpidia, showing every sign of stimulation, swimming about vigorously among the corpses of those which have been killed by the same dose. A slight increase in the dose, say an extra ten per cent., will kill off the whole culture. A decrease of ten per cent. produces only stimulation. It is clear, in this instance at any rate, how narrow is the margin which separates these diametrically opposite effects. In radio-biology—if we may be permitted to coin the word—as in other sciences, exact measurement is the key which unlocks the door of knowledge.

It is no part of the purpose of this article (the attempt would be impossible in any case) to give a résumé of the vast amount of observations made on the action of X-rays on living matter. It is doubtful whether most of them can throw much light on the fundamental problem which underlies them all. In irradiating an animal, or even a tumour growing on an animal, we are dealing with a part of a highly organised and closely interrelated structure, and any effects which are observed may be merely secondary and only indirectly due to the irradiation. So true is this that it applies even to the parasites on the body. Bacteria, for example, are notoriously resistant to the action of the rays when exposed in a pure culture. On the other hand, the same bacteria infecting a wound will often be killed by quite small exposures to the radiation, and such exposures are now frequently used as a means of clearing and healing a wound. The problem, difficult enough in any case, only becomes manageable if reduced to its simplest form, and the simplest form in biology is the individual cell.

We are fortunate in possessing at least a preliminary study of the effect of X-rays on the individual cell. Methods have now been perfected by which it is possible to remove a number of cells from the tissues of a live animal and to cultivate them for long periods in glass vessels, where they continue to thrive and multiply, quite independently of the fate of the animal of which they were once a part. Dr. Strangeways has studied the action of X-rays on these isolated cells, and a preliminary account of his work was communicated a year or so ago to the Royal Society. One of the striking facts which emerges from his work is that it is extremely difficult to destroy a resting cell by the action of the rays. Doses far heavier than could be safely applied to the human skin leave them apparently unaffected. Further observation, however, showed that this absence of effect was only apparent. The cells had been very vitally affected, but the effects of the rays only became visible when the cells began to divide.

The first effect of the rays, produced by quite short exposures, was to lessen very materially the number of cells passing through the process of cell division, or mitosis. Dr. Strangeways records that an exposure of only 5 of Prof. Friedrich's units produces an

appreciable diminution in the number of cells passing into mitosis. With a dose of 10 units the number was still less. After 15 units only a few cells in mitosis were visible, but the phenomenon was seen occasionally until the exposure reached as much as 85 units. Thus while a small dose of X-rays is sufficient to prevent the majority of the cells from dividing, a much larger dose is required before the whole of the cells are affected.

Dr. Strangeways has not yet provided us with a numerical estimate of this effect, but we hope that he and his collaborators may be able to do so before long. In the meantime, if we attempt to express his descriptions graphically, the curve which we shall have to draw relating the number of cells in mitosis with the exposure to the rays will be one which, plunging rapidly downwards at first, approaches zero asymptotically for prolonged exposures; it will, in fact, resemble closely an exponential curve. Now a curve of this type suggests strongly that the effect we are considering is a probability effect—in other words, that whether a cell will or will not go into mitosis after a given dose of X-rays is a matter of chance, the probability of its not doing so becoming greater as the dose is increased. This variability may, of course, be in the cell. Some may be more susceptible to the action of the rays than others. It is always legitimate, though not very helpful, to invoke the biological factor. I have ventured to suggest the possibility that it has nothing to do with the cell, but lies in the nature of the agent which we are using against the cell, that is, in the X-rays themselves.

An analogy, which is in fact a very close one, may help to make the matter clear. Suppose that we were firing at a swarm of midges with a machine gun. The number we should hit per second would be proportional to the number present in the swarm. At first we should claim a large number of victims, but, as the swarm gradually melted under our fire, the chance of hitting a midge would become smaller and smaller. To hit the last two or three would entail the expenditure of much ammunition and considerable patience. The survivors, however, would not owe their prolonged existence to any biological factor, or to any immunity either inherent or acquired, but simply and solely to their good luck. The number of survivors would, in fact, decrease exponentially as the number of bullets fired into the swarm increased.

Now, as Prof. C. T. R. Wilson's photographs show us very graphically, a beam of X-rays is very much like a swarm of bullets—only a negligible proportion of the atoms in the path of a beam of X-rays are affected in the least by the passage of the beam. It is quite easy to show that if the rays are conveying a dose of one unit per minute, as was the case in Dr. Strangeways' experiments, an individual atom would be effectively hit by the radiation on an average only once in a million years. The probability of a hit increases with the size of the particle, and a tissue cell would receive on an average about 14 hits per second, but as a hit is a matter of pure chance some would clearly receive more and others less than the average. This variation becomes more important as the size of the particles becomes smaller, and some of the important structures in the cell are much smaller than the cell itself.

It is not difficult to calculate what size the structure must have to fit in with the curve which we have constructed from Dr. Strangeways' description, on the assumption that a single hit registered by the rays on this particle suffices to put the cell out of action. Its diameter, assuming it to be spherical, would have to be about 1/2500 m.m. This is of the order of magnitude of the centrosome, a body which is considered by many biologists to play an important part in the process of cell division. With a target of this size, half the cells would be put out of action with an exposure of 12 units, 25 per cent. would survive a dose of 24 units, while 6 per cent. would still be capable of mitosis even if the dose were increased to 48 units. It will be seen how closely these numbers fit the phenomena we have described. It seems possible, to say the least, that the quantum theory must be taken into account in biology as well as in physics, and that a single cell may have a much more direct and painful appreciation of the existence of quanta than is possible to our grosser senses.

The scanty data which we possess on the action of X-rays on living cells indicate that the simple exponential relation which we have suggested is rather exceptional. The curve relating the number of survivors to the dose of X-radiation is generally sigmoid in shape. Practically no effect is produced until the dose exceeds a certain value. After this point is reached the number of cells affected increases rapidly, but there are always a few which survive much larger doses than the average. Curves of this kind are given by Dr. F. C. Wood, as expressing the result of his recent experiments on the effect of X-rays on cancer cells *in vitro*. Theoretically, we get a relation of this kind if we assume that a definite succession of hits is required to produce the result we are aiming at—say, for example, the destruction of the cell. I have given a calculation of the form of the curve on this assumption in a recent paper before the Cambridge Philosophical Society. A very considerable amount of rather tedious work will be necessary before sufficiently experimental results can be obtained to afford a real test of the theory, but the results so far accumulated are distinctly promising.

It need not be emphasised that these attempts to drag the biological action of X-rays into the domain of physics are extremely tentative. It is possible, even probable, that in the ultimate issue we shall find in the living cell something which transcends all physics and chemistry, but this is no legitimate excuse for failing to push our sciences to their extreme limits. Whatever the ultimate result may be, we are sure to find much of interest by the way. The primary effect of the absorption of X-rays by an atom, in fact the only effect of which physicists are aware, is the expulsion of a high-speed electron from the atom. That, it would appear, must be the starting point of any purely physico-chemical theory of the action of X-rays on living matter. What subtle series of changes is thus initiated in the complex chemical compounds which make up the cell is a problem, like that of the song the syrens sang, the answer to which no man knows, but which may not be beyond the wit of man to conceive. Nature, as usual, leaves us guessing. That is precisely why we find her so fascinating.

The Rhynie Crustacean.

By Dr. W. T. CALMAN, F.R.S.

MR. D. J. SCOURFIELD'S memoir "On a new Type of Crustacean from the Old Red Sandstone (Rhynie Chert Bed, Aberdeenshire), *Lepidocaris rhyniensis*, gen. et sp. nov." (*Phil. Trans.* B, 415, 1926), which has already been noticed in NATURE (April 3, 1926, p. 498), is so important a contribution to arthropod morphology that no excuse is needed for directing further attention to some of the problems suggested by it.

In the first place, it should be emphasised that no other fossil crustacean is known with anything approaching the completeness with which Lepidocaris has been described by Mr. Scourfield. The only fossil arthropod, and in fact the only fossil invertebrate, which comes near it in this respect is the well-known *Eurypterus fischeri* as described by Holm. In the second place, in spite of its antiquity, Lepidocaris is far from being a primitive crustacean. In some respects (notably in retaining the biramous swimming antennæ of the nauplius) it is indeed more primitive than the existing Anostraca, but it shares with them many characters that are by no means primitive, such as the simplified mouth-parts, which are much more specialised than those of many Copepods. The development of male claspers, of Anostracan type, from the maxillulæ instead of the antennæ, is a surprising feature, the significance of which remains obscure. It may indicate that Lepidocaris is off the main line of Anostracan descent. It is doubtful also whether the absence of eye-stalks can be regarded as a primitive character.

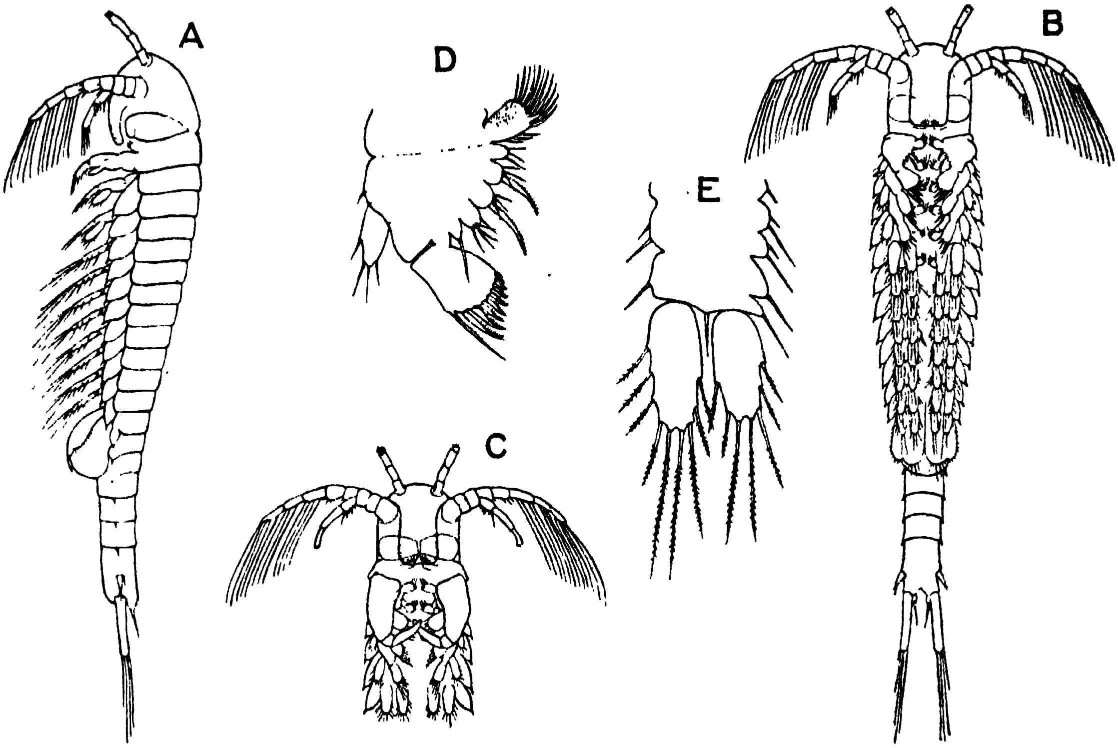

FIG. 1.—Restorations of *Lepidocaris rhyniensis*, Scourfield. A. Female, from the side. B. Female, from below. C. Male, anterior part of body from below. D. One of the first pair of trunk limbs. E. One of the trunk limbs of the posterior (seventh to eleventh) pairs. Approximate magnification, A, B, and C×27, D×9, E×10. (After Scourfield.)

One of the most difficult problems of crustacean morphology has been the correlation of the biramous type of limb found in so many Crustacea with the 'phyllopod' type seen in the Branchiopoda. Since Ray Lankester, in his classical memoir on Apus, showed that the Branchiopoda (or Phyllopoda) are the most archaic of living Crustacea, it has been generally accepted that the biramous has been derived from the phyllopod type. Lankester argued that the two branches of the biramous limb, the endopod and exopod, were derived from the two distal 'endites' or lobes of the inner edge of the phyllopodium. Huxley had earlier identified the exopod with the 'flabellum' of the Phyllopod and the endopod with the distal part of the stem or 'corm,' and this interpretation has been adopted by others, notably by Dr. Borradaile in a recent paper.[1] Lepidocaris would seem to provide the answer to this question, for while the first three pairs of its trunk appendages are phyllopodia, comparable without much difficulty with those of recent Branchiopoda, the following limbs are biramous; and it is perfectly clear that the exopod of the posterior limbs is equivalent to the flabellum of those in front, the endopod being the distal endite.

Dr. Borradaile inclines to the opinion that, in the

[1] "Notes upon Crustacean Limbs," *Ann. and Mag. Nat. Hist.* (9), 17, p. 193, 1926.

evolution of the Crustacea, the biramous form of limb has been arrived at more than once by different modifications of the phyllopod type. In view, however, of the simple biramous form of the limbs in the nauplius larva and in the Trilobites (the close relationship of which to the Crustacea cannot now be doubted), and of the persistency with which the same type emerges in the most diverse groups of Crustacea, it seems more reasonable to assume that it represents the deep-seated plan of symmetry on which all crustacean limbs are built. It is indeed possible that the phyllopod type preceded the biramous and that Lepidocaris preserves the transition from one to the other. This would seem to be the view taken by Mr. Scourfield, who, although he gives us little in the way of speculation, does imply that the biramous hinder limbs of Lepidocaris are derived from the phyllopodous type of those in front. It is, however, a very general rule among Arthropoda that specialisation begins anteriorly and works backwards; we should expect the posterior limbs to be the more primitive; and Lepidocaris gives the impression of having had primitively biramous limbs of which the more anterior pairs have been specialised in adaptation, no doubt, for some special method of collecting food.

A minor problem is presented by the lateral row of large scales (to which the generic name alludes) covering the bases of the trunk limbs. These suggest the small scales at the base of the outer edge of the limbs in Anostraca which are generally interpreted as the proximal exites of the limbs. In Lepidocaris, however, at the posterior end of the series, the scales are seen to be merely the pinched-off pleura of the somites. It is a matter for further inquiry whether the proximal exites of the Anostraca may not also be of pleural origin.

Perhaps the most unexpected feature of Lepidocaris, however, is the structure of the last segment of the body. In many Crustacea, in the larva if not in the adult, the termination of the body is forked. Very often this fork is nothing more than a notch in the hinder edge of the telson, but sometimes the two prongs of the fork are movable rods jointed to the segment, and in a few cases (Notostraca, Cirripedia) they are long, many-jointed filaments. In Lepidocaris we see clearly, for the first time, that these movable appendages are not, as has been generally supposed, homologous with the two branches of the notched telson. In the earliest larva found the telson is notched, and this notch persists in the adult to form what Mr. Scourfield calls the "primary furca." In the later larvæ, however, a pair of rod-like appendages grow out at the sides of the primary furca and become separated by articulation from the body of the telson, forming a "secondary furca" which is evidently the homologue of the articulated furca of Anostraca, Copepoda and Phyllocarida. In still later larvæ a second smaller pair of appendages appear at the sides of the telson in front of the secondary furca. Just above the articulation of each of these two pairs of appendages is set a small spine. The somites immediately in front of the telson bear no appendages, but each has, on either side, a similar spine, and as these spines are traced forwards they are plainly seen to be in series with the spines which tip the lateral scales already mentioned above the insertion of the limbs.

It seems impossible to avoid the conclusion that the appendages of the telson in Lepidocaris and the furcal rami of the groups mentioned above are serially homologous with the true limbs of the anterior part of the body. Now it is the general rule in the development of Arthropoda that the somites and their appendages appear and become differentiated in regular order from before backwards, new somites being added from a 'formative zone' in front of the telsonic region. In Lepidocaris alone do we find evidence of true appendages on the telson itself, *behind* the formative zone; and, emphasising the singularity of their position, the order of their development is the reverse of that of the pretelsonic appendages, the hinder pair appearing first.

It must be borne in mind that, at the time when Lepidocaris lived, the Crustacea had already behind them a long evolutionary history. It is now known from Walcott's remarkable discoveries that, so early as the Middle Cambrian period, a varied crustacean fauna existed and that several of the forms had at least a superficial resemblance to Anostraca. Unless some chance discovery, as fortunate as that at Rhynie, and an investigator with Mr. Scourfield's indefatigable patience and skill, combine to reveal a great deal more than we know at present about the structure of these early forms, speculations on phylogeny must go very cautiously.

Obituary.

Dr. Edward J. Bles.

By the recent death of Edward J. Bles, zoological science has lost a devoted worker whose qualities of mind and character were of the highest. It is the faith of many of his friends that, but for factors of temperament, and health, he would have become a leader of thought in the subject of his choice. His publications, though of high merit, were relatively few; but his intimates know that they were far from representing all that he accomplished, and are aware of the temperamental restraints but for which he could and would have published much more. He was one of those investigators—deserving sympathy from colleagues with easier standards—who would fain allow publication to wait for perfection, and yet realise even better than others that perfection never arrives. In spite of such inhibitions, or perhaps because of them, his published output is of high value and stamped with the quality of absolute reliability.

For elementary teaching, or, at any rate, for the shackles of departmental teaching and organisation, Bles had some distaste. On the other hand, he was the ideal colleague and one of the most educative influences for the young research worker. He would give his time and ingenuity for days to devise methods for another's work; he was a most sincere and painstaking critic and there never was any one with whom it was more delightful to share the joys of discovery or the fruits of victory. Yet he greatly prized independence, and the freedom to work out his own ideas on his own

lines. Being possessed of sufficient private means, Bles was therefore finally led to avoid all official posts, and for nearly twenty years he worked, first at Iffley, Oxford, and later, until the end, at Cambridge, in private laboratories equipped by himself. This involved, of course, some degree of isolation, and the additional factor of weak health finally led him to become scientifically somewhat of a recluse. In visits from scientific friends, however, he always took the greatest pleasure, and, to the end of his life, those who had the privilege of paying such visits profited always from contact with a truly philosophic mind and a stimulating personality. His wide learning was at the service of all.

Born in 1864, he was the son of A. J. S. Bles of Manchester. When fourteen years old he was sent to a school in Hanover where the teaching of science seems to have been exceptionally good. Family interests led him at the age of eighteen years to start in his father's business at Manchester; but his own interests directed him from the first into scientific company. He joined the Manchester Microscopical Society and became its secretary. Thus arrived the turning-point of his life. He came under the influence of Milnes Marshall, who saw his bent and genius, and for whom Bles then acquired, and ever afterwards retained, great love and admiration. He joined the Owens College, attended Milnes Marshall's classes, and in 1890 became, with his teacher, joint author of papers dealing with the development of amphibia, a subject which for some time remained one of his chief scientific interests. About this time he went to occupy a table at Naples and returned to carry out the duties of junior demonstrator of zoology at the Owens College. From 1892 until 1894 he was Director of the Marine Biological Association's Station at Plymouth. He went up to Cambridge in 1895 and took a research degree in 1898. When Prof. J. Graham Kerr was appointed to the chair of natural history at Glasgow, Bles accompanied him as his assistant and remained at the University until 1907, when he went to live at Iffley, Oxford.

In 1911 Bles removed to Cambridge. Before his last migration his scientific reputation had been made by the publication of important papers; especially by one which appeared in the *Transactions of the Royal Society of Edinburgh* in 1905 on the life-history of *Xenopus Lævis*, and another dealing with the development of certain Anura published in the volume issued by the Cambridge University Press as a memorial to John Samuel Budgett. Of these two papers describing work of fundamental importance, Prof. W. E. Agar writes: "They are very characteristic of Bles' work and scientific attitude. He would take an immense amount of trouble over the smallest detail, lingering over it with a loving care. . . . The plates in these two papers could scarcely be surpassed, either for accuracy of detail or beauty of execution—the result of laborious co-operation between the author and the artist, Mr. A. K. Maxwell. It is worthy of note that these plates contain the first scientific illustrations produced by this artist whose work is now so well known to biologists." The interest of the artist in such work must have been stimulated by his early collaboration with an investigator like Bles, whose own love of accuracy and beauty of execution were so great.

After his Cambridge laboratory was equipped, Bles started to breed various species of rare amphibia, a difficult enterprise in which he had the assistance of his devoted wife. This work was carried out with elaborate care and led to most interesting scientific observations, especially with regard to certain little-studied aspects of metabolism, to the significance of which Bles was keenly alive. The most important work of his Cambridge period had been begun at Oxford. It consisted of an elaborate and highly original study of Arcella by microchemical methods, during which Bles developed a very beautiful technique and obtained results of great importance. Unhappily, the inhibitions to which reference has been made became exaggerated in his latest years, largely because of continued ill-health, and the results of this prolonged research, though known to many, have not yet appeared in print. A paper was practically finished, however, and very fine drawings are available for its illustration. Its publication will be secured in the immediate future under arrangements made in the author's will.

Bles was not merely a scholarly biologist in a very wide sense, he was also a man of fine general culture; music, literature, and the arts all made a vivid appeal to him. He had, moreover, a true sense of values and a very beautiful appreciation of the relative importance of things. His knowledge was of the widest, but so philosophic was the cast of his mind that synthetic thought was essential to him. He endeavoured always to see things as a whole.

F. G. HOPKINS.

PROF. V. A. STEKLOV.

PROF. VLADIMIR ANDREJEVICH STEKLOV, member and vice-president of the Russian Academy of Sciences, an eminent and well-known mathematician, died at Ialta (Crimea) on May 30.

Steklov was born in 1863 in the province of Nishni-Novgorod as the son of a country priest. He attended a classical school at Nishni-Novgorod and afterwards entered the University of Moscow to study medicine, but he soon left Moscow and went to Kharkov to study mathematics under Liapunov and became his most gifted pupil and lifelong friend. He graduated at Kharkov, took the usual degrees of magister and doctor of mathematics, and was appointed professor at this University. His first work, "On the Motion of a Rigid Body in a Fluid," was published in Russian in the *Memoirs of the Mathematical Society of Kharkov.* In this paper he found several new 'integrable' cases of this problem. His thesis for his doctorate was "On the Principal Problems of Mathematical Physics." Such problems formed the basis of his subsequent numerous investigations, extending over a period of nearly thirty years. In these investigations he established his "théorème de fermeture," relating to the development of arbitrary functions in infinite series of "fundamental functions" depending on the roots of transcendental equations. Such expansions occur frequently in mathematical physics, the Fourier series being the simplest special case. Steklov introduced the necessary rigorousness into the problems of mathematical physics, in proving the existence of the solutions and the conditions of convergence for the series used. He summarised his researches in a treatise "On

the Differential Equations of Mathematical Physics" recently published by the Russian Academy of Sciences in two volumes. The complete list of his scientific papers contains about 120 items. These papers are published mostly in French, in the *Memoirs of the Russian Academy of Sciences*, the *Annales de l'École Normale Supérieure*, the *Annales de l'Académie de Toulouse*, and others.

As a lecturer Steklov was widely known while he was professor in the higher branches of theoretical mechanics and mathematics, first at Kharkov and then at St. Petersburg (now Leningrad).

Steklov was elected a member of the Russian Academy of Sciences in 1910, and in 1919 became vice-president of the Academy. The task of the vice-president was at that time a most difficult one. The vice-president is responsible for all the administrative work of the Academy and of its numerous institutions; he has to control the yearly expenditure and to superintend the proper use of the funds. Steklov proved to be just as able an administrator as a man of science: with open mind, sound judgment and firm hand, he steered the Academy safely through the hardships of the years 1919–22.

A. KRILOFF.

WE regret to announce the following deaths:

Miss Gertrude Bell, oriental secretary to the High Commissioner of the Iraq, Baghdad, since 1920, and distinguished for her travels in and knowledge of the peoples of Arabia, on July 11.

Mr. A. G. Charleton, past president of the Institution of Mining and Metallurgy, and author of numerous works on ore-mining and treatment, on July 7, aged sixty-eight years.

Mr. W. Temple Franks, C.B., lately H.M. Comptroller-General of Patents, Designs, and Trade Marks on July 4, aged sixty-three years.

Mr. F. Harrison Glew, M.B.E., a pioneer in the utilisation of radium and its salts for the preparation of luminous paint and other purposes, on July 10 aged sixty-eight years.

Sir Peter Scott Lang, emeritus professor of mathematics in the United College at the University of St Andrews, on July 5, aged seventy-five years.

Dr. George R. Lyman, dean of the West Virginia College of Agriculture at Morgantown and previously pathologist in the Bureau of Plant Industry a Washington, D.C., on June 7, aged fifty-five years.

Rev. T. R. R. Stebbing, F.R.S., the distinguished naturalist and worker on Crustacea, on July 8, aged ninety-one years.

News and Views.

ON July 7, in the presence of a large and representative gathering in a spacious marquee, Mr. Neville Chamberlain laid the foundation stone of the new London School of Hygiene and Tropical Medicine, the result of a gift of 2,000,000 dollars from the trustees of the Rockefeller Foundation. The chairman of the Board of Management, Sir Alfred Mond, in introducing Mr. Neville Chamberlain, reviewed the steps which had led to the foundation of the School. He pointed out that the former Chancellor of the Exchequer, Sir Robert Horne, had recognised the great importance of such an institution and had agreed that the British Government should make itself responsible for its maintenance. As a result of representations made by Mr. Neville Chamberlain to the present Chancellor of the Exchequer the building was being expedited, a grant of 5000*l* per annum being made by the University Grants Committee and one of 4000*l*. per annum from the Rockefeller trustees for immediate developments. He was able to announce that though Sir Cooper Perry is retiring from the post of Principal Officer of the University of London, his services are being retained on the Board of Management of the School, of which he has consented to be vice-chairman. Mr. Ormsby-Gore, Under-Secretary for the Colonies, in a most lucid and convincing manner, spoke of his recent experiences on a tour of the colonies and his conviction that hygiene and sanitation are the most vital of all the problems connected with the future development of the vast territories under the charge of Great Britain. The importance of a school like that being founded in London could not be overestimated.

MR. NEVILLE CHAMBERLAIN said that the building, the foundation stone of which he was to lay, was a result of co-operation between the two great English-speaking nations. It had been noted that the teaching of public health in London is carried on in a number of separate institutions, and it was realised that its concentration in one school would undoubtedly conduce to greater efficiency in teaching and research work. It was further realised that public health is not only necessary in the British Isles, but is of even greater importance in the tropical possessions of Great Britain. It was this fact which led to the incorporation of the London School of Tropical Medicine, founded in 1899 by Mr. Joseph Chamberlain. The new School would deal with hygiene in its widest applications, and before it lies a future in which it would not only be of national but also of imperial and even world-wide importance. It is probably destined to be famous as the greatest centre in the world for research and instruction on one of the most beneficent of all the activities of the human race. Reviewing the departments of the new School Mr Chamberlain said these would comprise: (1) Physiology; (2) chemistry and bio-chemistry; (3) bacteriology and immunology; (4) epidemiology and vital statistics; (5) medical biology; (6) sanitary science and public health in general. The School would be fitted with the latest types of apparatus and equipment, and would develop a great teaching museum in graphic form, intended not only for the student of hygiene but also for those of the general public who would care to visit it. With this programme before it there is every prospect that post-graduate students would gather from all parts of the world, and there can be little question that men and women will receive the best possible instruction in the methods of disease prevention. After the foundation stone had been laid Dr. Andrew Balfour, Director of the School, presented Mr. Neville Chamberlain and Mr. Ormsby-Gore with seals as mementoes of the

important occasion, the success of which they had so ably ensured.

AT 29 Great Pulteney Street, Bath, a corporation committee, under the chairmanship of Mr. T. Sturge Cotterell, has erected the forty-second mural tablet in commemoration of distinguished people definitely connected with the city. This last one states that "In this house William Smith, the Father of English Geology, dictated 'The Order of the Strata,' December 11th, 1799." The house was that of the Rev. Joseph Townsend, and it was the Rev. Benjamin Richardson who held the pen. This, the first written statement of Smith's ideas, was distributed in many copies to geologists at home and abroad. The tablet was unveiled on July 10 by the president of the Geological Society of London, Dr. F. A. Bather, in the presence of the mayor and a company that included many leading geologists. The chief guests were entertained to lunch at the Guildhall by the mayor (Mr. Cedric Chivers) and mayoress (Madame Sarah Grand), after which a meeting at the Royal Literary and Scientific Institution was addressed by Dr. Bather.

DR. BATHER showed in his address how the conclusions of William Smith flowed naturally from his surveying work in the neighbourhood of Bath, and how the society of the city afforded a fertile field for their reception. Smith's leading ideas, a revelation to his contemporaries, formed the starting-point and the necessary foundation of all tectonic and all historical geology; they have been the only sure guide in the great industries of coal-mining and oil-getting; and they alone have afforded the proofs without which evolution would have remained an ineffective dream. Prof. W. B. Scott, of Princeton, emphasised some of these thoughts by reminding the company that Hutton himself had not conceived the possibility of an historical geology, and that among those who failed to understand the principles of William Smith even Herbert Spencer could be reckoned. Among other speakers were Profs. S. H. Reynolds and H. L. Hawkins, and the chairman, Mr. P. E. Martineau, who is doing so much to revive the geological museum of the Institution.

MATHEMATICIANS usually look to the British Association only to satisfy their curiosity as to progress in other subjects than their own, but for this year's meeting at Oxford an attempt is being made to provide a broad platform for expression among themselves. On three mornings Section A will divide, mathematics separating from astronomy and physics, and several speakers have undertaken to describe in terms intelligible to mathematicians generally, not merely to experts in one branch or another, recent lines of advance and outstanding problems that are being attacked in mathematics itself. Subjects are found in mathematical logic and in rational dynamics as well as in the central regions of analysis, and every problem is to be expounded by some one who is at work upon it. It rests with the mathematicians of Great Britain, amateur as well as professional, from the schools as well as from the universities, to prove by their attendance that an effort to give in simple language some idea of the present vitality of mathematics appeals to a genuine interest. Only a fraction of the possible subjects can be touched at one meeting, and if this year's experiment is successful, the British Association will have discovered a function which can be continued beyond the circle surrounding its present origin and may even be found to be regular almost everywhere.

THE interesting lecture given by Mr. C. F. Elwell on May 5 to the Royal Society of Arts on the past, present, and future of radio is published in the June number of the Society's journal. He divides the subject into radio telegraphy, telephony, and miscellaneous applications. He points out that it is possible to talk to ships at sea by an ordinary subscriber's telephone. Such relaying of wire line telephony has even been done after the speech has been transmitted 5500 miles. The rapid progress of broadcasting is due to the demand for it. There are already two million receiving sets in use in Great Britain, and five million in the United States. There is a field for the transmission of speech by radio over electric light wires and transmission lines. Considerable progress has already been made in this direction in Italy, Germany, and the United States. It will do much to relieve the overcrowded ether. The three-electrode valve has already cheapened the cost and considerably extended the field of telephony. A few years ago, conductors weighing 150 lb. per mile were necessary for long-distance transmission. Better speech is now possible over greater distances with conductors of only one-fifth the weight. Considering that millions of miles of telephone circuits are in existence and that extensive developments are in progress, the value of the copper that is being saved is very large. A picture of a cheque has been sent across the Atlantic by radio and has been honoured within an hour of its receipt. It is possible that picture films may be sent by radio. In the art of television notable progress is being made by J. L. Baird, and developments may be expected. Many problems in connexion with the prevention of collisions at sea and between aeroplanes in the air still remain to be solved. A solution of one of these problems would probably also be applicable to the other. Even in competition with submarine telegraphy, radio is making progress. Radio telegraphy carries 30 per cent. of the message traffic across the Atlantic.

ACCORDING to a telegram of July 6 from The Hague (printed in the *Times* for July 7), another serious earthquake since June 28 has occurred on the west coast of Sumatra, but the date is not given. The epicentre is said to lie between Fort de Kock and Solok—that is, some miles to the north or north-east of Padang. The brick houses that withstood the earlier shock were destroyed and the number of lives lost is placed at 400. The recent shocks occurred in a district lying many miles to the north-west of that visited by the great earthquake of June 12, 1893, but in a part of the island disturbed from time to time by destructive earthquakes, one of the most important being that of May 17, 1892. This latter

earthquake is of interest, as it was the earliest in which crust-movements were measured by a repeated triangulation of the district. Prof. H. F. Reid, from a study of the displacements (*Bull. Seis. Soc. Amer.*, vol. 3, 1913, pp. 72-79), infers that the movements took place horizontally along a N.N.W.—S.S.E. fault 150 or 200 km. in length, the west side moving to the N.N.W. and the east side to the S.S.E., the total relative slip being 3.5 or 4 metres. The movements, both in nature and amount, bear a close resemblance to those which took place along the San Andreas fault at the time of the Californian earthquake of 1906.

Replying to a question in the House of Commons on July 12, Mr. Ormsby-Gore, Under-Secretary for the Colonies, said that arrangements have been made by the Department of Scientific and Industrial Research for communicating regularly published and other information as to the work done under its auspices to Dominion Government research organisations, to the principal unofficial research centres, and to the Governments of India and the Colonies. In return, valuable information is being received by the Department from the oversea parts of the Empire Similar arrangements for the exchange of information on agricultural research are in force; and it is proposed that a conference on the subject of inter-Imperial co-operation in agricultural research shall be held in the autumn of 1927. Invitations to this conference were issued last year to the Governments of the Dominions, Colonies, and Protectorates.

A memorial tablet has been placed in the Dominion Archives building, Ottawa, in memory of sixteen members of the Canadian Arctic Expedition, 1913-18, who perished during the expedition in widely separated sections of the Arctic. In addition to the inscription "in memory of those who perished, Canadian Arctic Expedition, 1913–18," and the names in alphabetical order with the ranking of each, there is an inscription at the foot of the tablet: "for Canada and for Science—pour la patrie et pour la science." Of the five members of the scientific staff who are thus commemorated, one is a Canadian, son of the late Dr. A. E. Malloch, of Hamilton, Ontario, and a member of the Geological Survey of Canada. Henri Beuchat, anthropologist, was a distinguished writer on American archæology and ethnology from Paris. Bjarne Mamen, topographer of Oslo, Norway, had served on the Norwegian-Spitsbergen Expedition before taking part in the Canadian expedition. James Murray, oceanographer, and Alister Forbes Mackay, surgeon, were from Scotland, and had been with Shackleton in the Antarctic. Peter Bernard, master of the *Mary Sachs*, a native of Prince Edward Island, lost his life, as did Charles Thompson, seaman, while crossing Banks Island in the winter of 1916–17. André Norem, Daniel Wallace Blue and John Jones were buried on the north coast of Alaska, Baillie Island and Victoria Island, N.W.T. After the sinking of the *D. G. S. Karluk*, north of Siberia, in January 1914, four men were lost attempting to reach Wrangel Island over the sea ice: James Murray, Alister Forbes Mackay, Henri Beuchat, and a seaman, Stanley Morris. Another party of four, led by First Mate Alexander Anderson, consisting of Charles Barker, John Brady and Edmund Golightly, seamen, succeeded in reaching Herald Island, but their fate was not known until a whaling vessel calling at the island in 1924 discovered the relics of the party on the beach. George Breddy, seaman, died on Wrangel Island, as the result of an accidental gunshot wound, and George Malloch and Bjarne Mamen, perished from scurvy at Rodger's Harbour, Wrangel Island, in May 1914.

Sir J. C. Bose, of Calcutta, has been giving lectures and demonstrations recently in Great Britain on plant stimulus and response. This is a subject to which he has devoted his energies for many years, and he has devised various delicate instruments for magnifying the minute responses of the plant to stimuli. Plant physiologists have not hastened to take up the use of such instruments, which would surely by their delicacy yield interesting results in the hands of any skilled experimenter. There is still much to learn about plant response, and Sir Jagadis has done useful work in directing attention to the delicacy of the plant as a responding mechanism. In a recent lecture at the Royal Society of Arts he referred to the sensitiveness of the plant to ether vibrations, not only to visible light but also to the ultra-violet and to octaves of long invisible waves. He also referred to the death spasm accompanied by an electric discharge, which he believes to take place when the plant dies but before it begins to droop and wither.

The memory of Benjamin Harrison and his life long devotion to archæology, and particularly to the study of the evidence of man's earliest handiwork in the form of stone implements, will be appropriately preserved as a result of the efforts of the promoters of the "Benjamin Harrison Memorial Fund." On Saturday last, July 10, a tablet to his memory was unveiled in Ightham Church, and as part of the memorial ceremony the title-deeds of the Coldrum Stone Circle at Trottiscliffe, Kent, which has been purchased out of the contributions to the Fund, were handed over to the National Trust. Admirers of Benjamin Harrison, who are many, will be gratified that the preservation of this most interesting relic of early man should be assured, and that it should be associated with the memory of one of the most devoted of the pioneers in archæological studies in England

A letter from Lord Onslow appears in the July issue of *Man*, putting forward a plea for the preservation of specimens of ethnographical interest in Great Britain at present in private hands. It is pointed out that the nineteenth century being primarily a century of settlement, as opposed to the two preceding centuries which constituted the age of discovery, it was pre-eminently the century of the collector, and there must remain in private hands a large number of ethnographical objects which were acquired before their use among primitive peoples had been superseded by articles of European manufacture. If immediate steps are taken, it should be possible to preserve a large number of objects of great ethno-

graphical and historic value, and in many cases to record their history and provenance. The Council of the Royal Anthropological Institute has appointed a committee to explore the possibilities of the situation. Lord Onslow has consented to act as chairman of the Committee.

WE are glad to know that it is proposed to establish a memorial to the late Mr. F. S. Spiers, secretary of the Faraday Society and of the Institute of Physics, to remind future generations of his valuable services to science and human welfare. It is suggested that a memorial lecture, to be paid for out of the interest on the fund subscribed, shall be instituted under the auspices of the Faraday Society. A committee to promote this appeal has been formed, with Sir William Bragg as chairman, and the sum of about 130*l*. has already been subscribed. We are sure that many who have been associated with Mr. Spiers in scientific meetings and the preparation of papers and reports will desire to add to this sum Contributions should be sent to the assistant honorary secretary, Miss M. Parsons, of the Faraday Society and the Institute of Physics, at 90 Great Russell Street, W.C.1. Cheques should be made payable to Prof. A. W. Porter and crossed " F. S. Spiers Memorial Fund A/c."

ARRANGEMENTS are being made by the Regional Survey Association to hold a meeting at Richmond, Yorkshire, on September 1-10 next The district, which is rich in historical associations and natural beauty, will be studied from as many points of view as possible—physical, geographical, historical and social. Lectures will be given by specialists in these subjects, and these will be supplemented by practical work and observational excursions in the neighbourhood. The latter will cover Barnard Castle, Muker and Keld, Leyburn in Wensleydale and Catterick Bridge, localities which will afford exceptionally favourable fields for research. Full particulars may be obtained from the Secretary, Leplay House, Belgrave Road, London, S.W.1.

THE report on the Health of the Army for the Year 1924 has recently been issued (London: H.M. Stationery Office, 1926. 3s. 6*d*. net). Efforts have been made to expedite issue, with the result that this report appears within about four months of its predecessor. A melancholy interest attaches to it, for it is signed by the late Sir William B. Leishman, Director-General, A.M.S The improvement in the health of the troops, noted in previous reports, was maintained during 1924, with the exception that the admission ratio shows a fractional increase over 1924, due to influenza Tonsillitis again caused a large number of admissions to hospital, and middle ear disease heads the list of diseases causing the greatest loss of men through invaliding. Interesting details are given both of the medical measures and equipment employed in the army in the treatment of disease and of the hygienic and other measures now taken to prevent disease and to improve the lot of the soldier.

THE technical programme has now been issued of the sectional meeting of the World Power Conference, to be held at Basle on August 31-September 8 in the halls of the International Exhibition for Navigation and Utilisation of Hydraulic Power. Five broad subjects of discussion have been arranged: (*a*) utilisation of water power and inland navigation, (*b*) exchange of electrical energy between countries, (*c*) relation between the hydraulic and thermal methods of generating electricity, (*d*) electricity in agriculture, (*e*) railway electrification. At the conclusion of the meeting, an official tour of Switzerland will be made, lasting from September 9 until September 12. Communications for the British National Committee should be addressed to the Secretary, World Power Conference, 36 Kingsway, London, W.C.2.

ON May 30, Dr. Truman Michelson, of the Bureau of American Ethnology, left Washington for the reservation of the Fox Indians at Tama, Iowa, where he will study the ritual of the religious ceremonies which are held in the spring and autumn. He will afterwards proceed to Wyoming to study the language of the Arapaho, which appears to be a widely divergent derivative of Algonquin. This is the fifteenth consecutive season that Dr. Michelson has spent among the Fox Indians, from whom he has collected a large amount of anthropological material. Some of this material appears in the latest volume published by the Bureau of American Ethnology, but the greater part awaits publication owing to the lack of funds. This is the more to be regretted as the Fox are a reticent people with an interesting history—they contributed materially to the loss of Canada by the French to the British by breaking up the trade route from Louisiana to Canada—and although they suffered some admixture with European blood in the early days of American colonisation, they have since stubbornly maintained their racial purity.

AN announcement has been issued of the fifth competition, for 1926, for the Patxot prize, which was instituted in 1922, primarily to stimulate research in Catalonia in the physical sciences and mathematics, by M. Raphaël Patxot i Jubert. The prize for 1926 will be 5000 pesetas (present value about 160*l*.), and the jury of award will consist of two specialists and the founder of the prize, who retains rights of publication. Competing works should be addressed to Rue de la Cucurulla, 1 et 3, Barcelona, and must be received by December 31, 1927. They may be in Catalan, any Latin tongue, or English, and the subject is the meteorology of the western Mediterranean, and more especially of the Catalan coast. One competition for 1924 (10,000 pesetas) for a documented monograph relating to the history of the physical sciences or mathematics in Catalonia in the Middle Ages, closes on December 31, 1928. Another prize for 1924 was not awarded, although three memoirs on physiographic studies of Catalonia were entered, for which minor awards were given. The prize for 1925 (5000 pesetas), which closes on December 31, 1926, is for a monograph in Catalan on atmospheric physics applied to Catalonia.

UPON its title page the *Journal of the Royal Agricultural Society of England* bears the Society's distinctive motto "Practice with Science." In view of the latter epithet it is entitled to notice here. Under the heading "Special Articles" there are in vol. 86 eight papers, of which many of the authors bear well-known names either in 'Practice' or 'Science.' The most arresting contribution is one on the "Use of the Dynamometer in Soil Cultivation Studies" by Dr. Keen, of Rothamsted. This gives a summary of the novel results obtained by the use, for the first time, of an instrument of real precision in measuring the draft of tillage implements, the unexpected result being that draft does not necessarily increase *pro rata* (even in linear dimensions) with speed. In regard to tillage problems, however, one may be permitted to suggest (as Wren Hoskyns believed almost a century ago) that the future of economical tillage lies with a rotary implement rather than with the plough, designed, as the latter is, to suit the slow-moving ox or horse. The Oxford Research Institute in Economics contributes a timely article on the sugar-beet position. For the first time in the rather turgid literature on this subject, attention is directed to the fact that the introduction of this crop on any extensive scale necessarily contracts, in a serious degree, the provision of animal food, and consequently raises questions of fundamental economic importance to British farming, dependent as this is, to a pre-eminent degree, on animal husbandry. The Society has recently established a Research Committee, but judging by its present report its title should be, with greater justice, the Field Investigation Committee; for it is almost wholly concerned with interesting and valuable practical trials in such subjects as green manuring, lucerne growing, malting barley trials, grassland improvement, and so forth.

PROF. A. F. VON EISELSBERG, professor of surgery in the University of Vienna, has been awarded the Lister medal, given by the Royal College of Surgeons of England, for distinguished contributions to surgical science.

THE Council of the National Institute of Agricultural Botany has awarded the Snell Memorial Medal for the year 1925 to Dr. R. N. Salaman. The medal is given annually to mark distinguished work in the sphere of potato husbandry, and has been awarded to Dr. Salaman in recognition of his eminent services in the study of the problems connected with the breeding and the diseases of potatoes. The medal will be presented to Dr. Salaman at the public inspection of the trials at the Potato Testing Station, Ormskirk, on August 19.

PROF. CARL DIENER, professor of palæontology in the University of Vienna, has been elected a foreign member of the Geological Society. The following have been elected foreign associates of the Society: Dr. A. L. Day, of the Geophysical Laboratory, Washington, D.C.; Prof. Otto Jækel, professor of geology and palæontology in the University of Greifswald; Prof. Maximin Lohest, professor of geology and physical geography in the University of Liège; and Prof. Pierre Pruvost, professor of geology and applied mineralogy in the University of Lille.

THE Vienna Academy of Sciences has elected as honorary member Dr. Ernst Fuchs, emeritus professor of ophthalmology in the University of Vienna, and the following as foreign corresponding members: Prof. G. H. Hardy of Oxford, Dr. C. V. L. Charlier of Lund, Dr. S. Ramon y Cajal of Madrid, Dr. O. Richter of Brünn. Prizes have been awarded to Dr. A. Franke for his work on the formation and transformation of glycols, and to Dr. G. Stetter for his work on the determination of the masses of atomic fragments. The prize offered at the instigation of Dr. Hans Vaihinger, president of the Philosophical Society "As-if," for an essay on "Fictions in Mathematics" has been awarded to Dr. C. Betsch of Kannstatt, and Dr. M. Draeger of Chemnitz has been highly commended.

THE publication of the *British Journal of Experimental Biology* has been undertaken by the Cambridge University Press. It is the organ of the Society for Experimental Biology, but contributions are accepted from other than members of that body. It is edited by Mr. J. Gray, with the assistance of Dr. F. A. E. Crew and others.

MESSRS. Dulau and Co., Ltd., 34 Margaret Street, W.1, have just issued a useful catalogue (No. 143) of some 1200 second-hand books on phytopathology and horticulture. It is conveniently arranged under the headings: phyto-pathology, fungi, mosses and hepatics, lichens, diatoms and desmids, algæ and plankton, ferns and lycopods, cryptogamia, botany, floras, gardening, herbals, etc.; and agriculture and economic botany.

ANOTHER of Messrs. H. Sotheran and Co.'s well-known catalogues has just reached us. Its number is 800 (or "Catalogue of Science and Technology," No. 111, Part vii.: x. and xi.), and in it are particulars of nearly 4000 second-hand works on chemistry and chemical technology. The classification is as carefully carried out as in earlier parts of the catalogue, and there are the valuable bibliographic details and comments which one looks for in this publication which is of the greatest usefulness to collectors and librarians of scientific publications. Applications for the catalogue should be made to Messrs. H. Sotheran and Co., 140 Strand, W.C.2.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant lecturer in the Education Department of the University of Leeds with, preferably, qualifications and experience in teaching science or geography—The Registrar (July 19). A demonstrator in mathematics at the Royal College of Science, and a demonstrator in mathematics at the City and Guilds (Engineering) College—The Secretary, Imperial College of Science and Technology, South Kensington, S.W. 7 (July 26). An assistant librarian at the University College of North Wales, Bangor—The Registrar (July 26). A lecturer in physical chemistry in University College, Dundee—The Secretary and Registrar, The Uni-

versity, St. Andrews (August 16). A lecturer in zoology at Armstrong College, Newcastle-upon-Tyne—The Registrar (August 28). A principal of the University College of North Wales, Bangor—The Registrar (October 1). A chief science mistress at the County School for Girls, Beckenham; or a temporary post until Christmas and a permanent post in September or January—The Head Mistress (marked 'Science Post'). Directors of propaganda for calcium cyanamide in India and in Ceylon respectively—The Director of Propaganda for Calcium Cyanamide, Adelaide House, King William Street, E.C.4. An assistant entomologist under the Empire Cotton Growing Corporation for work on cotton pests in the Union of South Africa—The Secretary, Empire Cotton Growing Corporation, 2 Wood Street, Westminster, S.W.1. An assistant master at Soham Grammar School to take charge of practical instruction in Nature study, horticulture, and the elements of agricultural science—The Secretary for Education, County Hall, Cambridge.

ERRATUM.—In the issue of July 10, p. 64, col. 1, line 21 of paragraph on "Silver Iodide in Gelatin Iodo-bromide Emulsions": for "440 mm." read "440 $\mu\mu$."

Our Astronomical Column.

FINLAY'S COMET.—Mr. S. Hasunuma, of Tokyo, who has calculated the perturbations of Finlay's comet (*Astr. Nach.* 5453), finds that they delay the perihelion passage until August 7, which is some six weeks later than the approximate value assumed in the B.A.A. Handbook. The effect is to bring the comet into a more favourable position for observation, so that its detection this summer is now quite probable. The following ephemeris for 0^h is based on perihelion August 3·0

	R.A.	N. Decl.
July 18.	3^h $3{\cdot}7^m$	13° 48′
„ 26.	3 40·9	16 38
Aug. 3.	4 16·9	18 56

A change of +4 days in perihelion date diminishes the R.A. by about 10^m and the Decl. by about 90′. The comet must be looked for low in the east just before dawn.

THE COMING PERSEIDS.—The earlier meteors of this famous shower have been perceptible since the opening of July, and it is very interesting to trace the development of the display and the motion of its radiant from night to night through the constellations of Andromeda and Perseus.

This year should provide a shower of more than usually prominent character, for the moon will be new on August 8 and practically invisible at the period of the maximum.

The radiant moves E.S.E. in a line corresponding to 39° north of the ecliptic, and its positions on four dates in July, August, and September are as follow:

		Star near
July 15 . .	15° +47°	Psi Andromedæ
August 1 .	31 +52°	10° N. Gamma Andromedæ
August 15 .	49° +57½	8½ N. Alpha Persei.
September 1 .	69° +61½°	2° W. Beta Camelopardalis.

New observations should be applied to test the accuracy of these approximate positions. The Perseids usually leave streaks, and these are occasionally very enduring in the case of the brighter meteors, so that their directions of flight may be recorded with considerable fidelity.

Some hundreds of the Perseids have had their real paths computed, and there seems little necessity for further data of this sort except on nights near the commencement or end of the display, when double observations will give good and certain radiants. It will be interesting, however, to learn more of the minor contemporary showers. Observers, in comparing one year's results with others, should make such allowances as appear to be required respecting the weather, moonlight, etc. The hours of observation are also important as greatly affecting the altitude of the radiant and the number of meteors distributed.

THE SIMEIS OBSERVATORY REFLECTING TELESCOPE.—The report of the Pulkovo Observatory for 1925 has been published. The most important work done during this year is considered to be the erecting of the 40 inch (1 metre) reflecting telescope at the Simeis Observatory in the Crimea, which is affiliated to the Pulkovo Observatory. The reflector was made at the works of Sir Howard Grubb and Sons, Ltd., and a brief description of it is to be found in NATURE of April 12, 1924 (vol. 113, p. 550).

In the report some interesting details are given relating to the erection of the instrument. The masonry was started on June 6, 1925, and at the beginning of November the mechanical parts of the revolving dome were so far ready that the erection of the reflector could be proceeded with. Finally the large mirror was inserted in its case with great precautions, and was fixed to the tube.

By the end of the year the reflector was mounted, with the exception of the clock-work. Movement of the instrument by hand is easy, although the total weight is 6½ tons. The mechanical parts of the instrument work perfectly, the construction being the highest type of technical achievement.

The programme of research being dependent on the quality of the mirror, a preliminary laboratory test was made during the summer months by Hartmann's method at the centre of curvature of the mirror. The conditions during the test were purposely chosen far from favourable and approximated closely to the average conditions in the dome. Quite apart from the mounting, it is very important to have a thorough knowledge of the shape of the mirror. A series of independent photographs were taken on different days and were examined, in order to get an idea of the mirror's shape. The following details are noteworthy. The results of measurements of different photographs taken on the same day give very nearly the same results. The zonal aberration is exceedingly small, of the same order as the errors of measurement. The average departure in different zones is about 0·03 mm. The accuracy of the configuration of the mirror (departure from a paraboloid) is of the order of $\frac{1}{10}$ of a wave-length. According to Hartmann's classification, the mirror may be considered as "hervorragend gut" (exceedingly good). The results of the analysis leave no doubt that the mirror has a perfect shape, and in comparison with data published for other big mirrors it certainly ranks among the best.

Research with such an excellent instrument on both the mechanical and the optical sides is expected to give good results in the various interesting problems for which the instrument is intended to be used.

Research Items.

RELATIVE VALUE OF FACTORS INFLUENCING INFANT WELFARE.—In Parts 3 and 4 of the first volume of *Annals of Eugenics*, Miss Ethel M. Elderton concludes her exhaustive study of data from Rochdale, Bradford, Blackburn, Preston and Salford on infant viability and summarises her conclusions. These, both positive and negative, are of fundamental importance. The factors, which are shown to be more or less closely associated with viability, are the health of the mother, the health of the baby at birth and, of much less significance, the maturity of the mother and the position of the child in the family. The evidence is conflicting; but in some towns there appears to be a rather heavier death-rate among the infants of women under twenty-three years of age. Miss Elderton has also formed the opinion that there is a higher infant death-rate among the first-born which may be concealed during epidemics of diarrhœa. Association with the habits of the parents and the occupation of the father is small; so is that with all other environmental conditions, *e.g.* poverty, whether judged by the income of the family or the wage of the man, and housing; while no evidence is afforded that children born at the end of a large family suffer in vitality, or that bottle-feeding in itself causes a high infant mortality. Nor, so far as infant mortality is concerned, has indoor sanitation any advantage over outdoor sanitation. The whole trend of the evidence is in favour of the view that the infant death-rate is selective. From the point of view of the race, also, the success of health visitation and inspection is in the right quarter, tending to assist chiefly the better portion of the community. Miss Elderton urges very strongly the need for fuller information to decide whether parental health and habits cause environmental conditions or whether these are responsible for parental health and habits. Much of the available evidence favours the first of these alternatives.

TEARS.—Prof. Maurice Canney, in the *Journal of the Manchester Egyptian and Oriental Society*, No. 12, points out that there is a curious resemblance in birth and death ceremonies which may be due to the fact that birth, marriage, and death all mark a change of state, and the ceremony may be one of initiation into new life. Though it may be natural to express grief by howling, wailing, and weeping, much depends upon how things are done. Though black is sometimes stated always to have been a symbol of death, it seems frequently to have been of life-giving significance, as, for example, in the use of antimony and henna as applied to new-born babes in Egypt. In the case of tears, two ideas have intermingled, but in a civilised community tears are almost exclusively connected with grief and pain, excluding the idea of life-giving, which is really the more primitive. The ceremonial weeping and bawling, which is a feature of mourning ritual in, for example, China, Africa, and elsewhere, clearly has a special significance, its object being not to express grief, but to awaken and reanimate the dead. Tears may be compared to the shedding of blood. The ceremony of cutting oneself for the dead renewed the bond of union with the living. Further, tears being creative, they are potent to produce fertility and ensure good crops. Hence in a number of instances in human sacrifices, the victims are frequently tortured to make them shed tears.

PREHISTORIC EARTHWORKS IN NORTH CARDIGANSHIRE.—A regional survey of the prehistoric earthworks of North Cardiganshire by Mr. I. T. Hughes in vol. 4 of the *Transactions of the Cardiganshire Antiquarian Society* gives a summary description, with plans, of 28 earthworks which can be classified as true 'hill-top' camps. They are confined to a region north of a line drawn from the sea near Llanrhystyd along the Wyre Valley to Trawscoed, then towards Ystrad Meurig and along the valley of the Upper Teifi. There is, however, an important group along the Aeron Valley. North of the Wyre—Upper Teifi line they are isolated from the camps of western Montgomeryshire by the Plynlimon Range. No camp is below the 300 ft. contour and four are above the 1000 ft. range. The upward limit of camps coincides with that of cultivation and modern habitation. Some of the camps are situated in proximity to the sea and defend inland routes, and the distribution suggests that Llanrhystyd was a port of some importance, probably connected with the south coast of England by the conjectural Bronze Age route Southampton—Harlech with a branch from Evesham, "aiming probably at Aberystwyth or some port south of that town." The chief metalliferous areas of Cardiganshire are characterised by groups of camps. Place names associated with the camps near the sea, the valleys and the mining areas suggest Irish affinities which are supported by finds of a halberd, a flat celt, and a palstave of Irish design. The camps, therefore, would appear to be the centres of a community of Goidelic lead lords with close connexions with Ireland. Without the evidence of the spade it would be unwise to offer an opinion as to their age

SOIL PROBLEMS IN COTTON GROWING IN THE SUDAN.—The Sudan Government has published (Khartoum, January 1926) the report of a meeting of the chemical section of the Wellcome Tropical Research Laboratories, held at Wad Medani, in which the problems of cotton-growing in the Sudan Gezira were passed in review from the point of view of chemist, physicist, and biologist. This review is particularly noteworthy on account of Dr E. M. Crowther's discussion of the effect of the nitrogen supply It appears that, after the water supply, the most important soil factor in the Gezira is the nitrogen supply. Cotton cultivation in the Gezira in this respect shows an essential difference from the conditions prevailing in Egypt

OXYGEN REQUIREMENTS OF FISH.—Data have been presented concerning the oxygen requirements of different kinds of fish at various temperatures by J. A. Gardner (Min. of Agric and Fisheries Fishery Invest., Ser. I. vol. 3, No. 1, 1926: Report on the Respiratory Exchange in Freshwater Fish, with Suggestions as to Further Investigations. Pp. 17. London: H.M. Stationery Office, 1926 2*s.* net). At ordinary limits of temperature, the respiratory quotient varies between 0·6 and 1, but the majority lie round 0·8. Trout appear to be more sensitive to rise in temperature than the coarse fish examined. Even 25° C proved fatal to a large trout, though smaller specimens could be acclimatised to stand 25° for some hours. Goldfish can endure 30° C., but not 35° C.

ASIATIC AND AMERICAN ELEMENTS IN THE LEPIDOPTERAN FAUNA OF POLAR EUROPE.—The well-known Russian lepidopterist Prof. N. I. Kuznecov has been working for many years on the problem of the distribution of lepidoptera in the Polar regions. While a comprehensive work on the subject is in preparation, he publishes some preliminary results of outstanding interest (*Comptes rendus Acad. Scien.*, Leningrad, 1925). Many species of butterflies are characterised

by a discontinuous distribution, being present in polar Europe and in eastern Siberia, but not occurring in the wide area between the Yenisei and the Ural Mountains. This area, corresponding to the West Siberian plain, can only be explained by the West Siberian Sea, which existed in the Oligocene and extended as far southwards as the Aral Sea. This means that the age of the European circumpolar faunal elements, as well as of the Holarctic ones, must be estimated in any case as pre-glacial, or, more precisely, as pre-oligocenic. These pre-oligocænic circumpolar elements are probably autochtonous, which leads to the conclusion that the Arctic faunistic region may be considered as independent of the Palæarctic region. On the problem of possible origin of these ancestral Holarctic elements, which since the Palæogenic times have populated the whole northern zone of both Eurasia and America, Prof. Kuznecov is of the opinion that they originated in the Angaro-American continent, which embraced eastern Siberia and north western America down to Colorado and the Great Lakes, stretching westwards across northern Siberia to the White Sea.

MEDITERRANEAN STERNOPTYCHIDÆ.—Messrs. P. Jesperson and A. V. Tåning (" Report on the Danish Oceanographical Expeditions, 1908–1910, to the Mediterranean and Adjacent Seas." No. 9, Vol. 2 (Biology). A. 12 : " Mediterranean Sternoptychidæ," by P. Jespersen and Å. Vedel Tåning. Copenhagen: Andr. Fred. Høst and Søn, 1926. 35s.) continue the systematic account of the fishes belonging to the Sternoptychidæ taken by the Danish Oceanographical Expedition in 1908-1910 under the leadership of Dr. Schmidt. Together with Jesperson's previous report in this series on the genera Argyropelecus and Sternoptyx (Reports, vol. 2, A. 2), it forms a valuable account of the post-larval, adolescent, and where necessary, of the adult stages belonging to the species of this family occurring in the Mediterranean Many cases of doubtful synonymy are cleared up and a new species of the genus Cyclothone described. Much attention is given to the comparison and identification of the species, and numerous clearly executed figures accompany the text; maps are also given showing the horizontal distribution for each species. The information relating to seasonal, diurnal, and ontogenetic vertical migrations, as well as that relating to the horizontal distribution, is interesting and important. Very young larval forms seem not to have been found except in isolated cases; this being due in the authors' opinion to their small size and delicate nature, and to their destruction by the net. Post-larval forms are generally taken close to the surface, whilst typical metamorphosis stages are found in much deeper water, mainly from 500 to 1200 m w., depending upon season and geographical locality, and varying for each species; it seems, moreover, that the change in depth of living takes place suddenly, as intermediate stages have not been found at intermediate depths. Diurnal vertical migrations are undertaken by most of the adults, and, generally speaking, they are higher in the water in the summer than in the winter.

BIOMETRIC WORK ON VARIABILITY.—The *Izvestia Buro po Genetik i Eugenik*, No. 4, recently issued by the Russian Bureau of Genetics and Eugenics, contains five biometrical studies on variability, with short summaries in English or German. The longest paper, by Prof. J. Philiptschenko, on the variability of quantitative characters in twelve pure lines of soft wheats, considers the conditions under which relative values or indices are more suitable than absolute values for certain measurements. The resulting correlations are classified as (1) intrabiotypic, depending on reaction-norms within a biotype; and (2) intrapopulative, depending on the relations of the biotypes within a population. T. Liepin, in a study of variability in a Chrysomelid beetle, *Phædon cochleariæ*, finds by measuring larval stages that the variability gradually decreases with age, this decrease being due to internal factors, while unfavourable conditions are shown unexpectedly to cause increased variability. G. Pchakadze finds in *Daphnia pulex* that the young from fertilised eggs are nearly twice as variable as those from parthenogenetic eggs. He also claims that adult parthenogenetic Daphniæ are more variable than adults from fertilised eggs, and that while variability decreases with age in Daphniæ from fertilised eggs, it increases with age in parthenogenetic individuals. D. Diakonov shows briefly that bimodal variation need not necessarily mean genetic dimorphism. A. Zuitin deals with similar problems of variability in the grasshopper, *Dixippus morosus*, which is also parthenogenetic. He finds a decrease of variability during post-embryonic development, but concludes that if environmental conditions overbalance the internal regulatory processes within the animal, an increase of variability with age may result.

SOME PERIODS IN AUSTRALIAN WEATHER.—A discussion, by Dr. Edward Kidson, Assistant Director, Commonwealth Bureau of Meteorology, is published by the Bureau of Meteorology, Melbourne, Commonwealth of Australia, as Paper 1—extract from Bulletin No. 17. Mr. Hunt, the Commonwealth Meteorologist, in the introductory note states that Dr. Kidson has put into more precise form much that has for many years been common knowledge to Australian meteorologists, and he considers the discussion should lead to an advance in our knowledge of meteorological processes in the Australian region. The author has dealt with weather charts for more than thirty years. The close relationship shown between the annual latitude range of anticyclones and the Wolfer sunspot numbers is one of the results.

EARLY POLARISATION APPARATUS.—The issue of *Die Naturwissenschaften* for May 28 contains over the signature Kpl. an illustrated account of an apparatus for investigating the polarisation of light by reflection shown by J. Tobias Mayer to the Gesellschaft der Wissenschaften of Göttingen on November 21, 1812. It consisted of two parallel glass plates the back surfaces of which were blackened; the upper one received sunlight and reflected it vertically downwards to the second, which could be rotated about a vertical axis. It was, therefore, the apparatus now known as Norremberg's, although there appears to be no record of Norremberg having constructed his apparatus before 1842. Mayer's paper will be found in *Commentationes Soc. reg. scien. Göttingen*, 1813, No. 9.

THE ATOMIC NUCLEUS.—The most recent of the suggestions as to the constitution of the atomic nucleus is that made by S. Ono in the April issue of the *Proceedings of the Physico-Mathematical Society of Japan*. He suggests that the nucleus consists of two parts, an inner and an outer. In the inner portion each proton or positively charged elementary particle is accompanied by an electron, while in the outer part each pair of protons has an electron. The volume occupied by the outer combination is on the average 1·1 times that occupied by the inner, and the combinations are uniformly distributed, the inner through the volume of a sphere, the outer through the shell surrounding the sphere, its outer radius

being on the average 0·6 times the diameter of an outer combination greater than that of the sphere. On this supposition the relation between the atomic numbers and the atomic weights of the heavier elements comes out in close agreement with the facts, but the number of possible isotopes is in excess of those found. Two groups projected from the outer nucleus constitute an α-ray, and the disturbance of the equilibrium of the atom results in the emission of two electrons from the rings outside the nucleus —the β-rays, which it is known are emitted in pairs.

Protection against Ignition by Perforated Plates.—It is rather astonishing to read of and more astonishing to see red flames—several inches in height—emerging through perforations in a metal plate into an explosive mixture of gases without igniting the mixture. Nevertheless this may be seen in the laboratories of the Safety in Mines Research Board at Sheffield, and the description of the experiments may be read in the second report on flameproof electrical apparatus with perforated-plate protection (Mines Department: Safety in Mines Research Board. Paper No. 21: Flameproof Electrical Apparatus for use in Coal Mines. Second Report: Perforated Plate Protection. London: H.M. Stationery Office, 1926. 1*s.* 3*d.* net). Messrs. Wheeler and Grice have shown experimentally that by allowing the escape of burning gases (produced by the explosion of fire-damp and air in a bomb) through suitably spaced holes in a metal plate, the escaping gases—still visibly burning—may be so cooled down by conduction and expansion as to be incapable of igniting a 10 per cent. methane-air mixture surrounding the bomb. When two suitably perforated brass sheets, such as are manufactured commercially, are superposed—with a small interval between them—as part of the cover of a switch-box, an explosive methane mixture can be fired inside the box without igniting a similar mixture outside.

Combustion under direct Electrical Discharge. — In an interesting paper published in a recent number of the *Proceedings of the Royal Society*, Messrs G. I. Finch and L. G. Cowen describe their experiments on the combustion taking place when a direct discharge is maintained between metallic electrodes in electrolytic gas at pressures between 20 mm. and 100 mm. of mercury. In the inflammation of gases there is a pre-flame period of slow combustion when chemical combination begins; this process usually increases automatically in intensity until the normal flame appears. But it is possible to maintain the flameless regime under special conditions. Some twenty years ago, Kirkby found that when a direct discharge was maintained in electrolytic gas under low pressures, the water formed (without flame) was proportional to the quantity of electricity passed, and that the combustion was independent of the nature of the electrodes and occurred at all points of the discharge. Later workers have chiefly studied ignitions by high-tension discharges from a coil or by capacity-discharges from a condenser. The present authors have sought to eliminate so far as possible all 'capacity' effects, and to maintain a perfectly steady discharge with a glow free from striations and flickering—so that the combination might be related only to ionisation and not be due to high temperature. Under the conditions maintained by the authors, the rate of formation of water was found to be directly proportional to the current. By limiting the current, the combination may be confined to the glow round the cathode, when it is independent of the gas temperature and pressure, but varies with the nature of the electrodes.

Direction Finding by Radio.—The Department of Scientific and Industrial Research has just issued the third part of the report on the variations of the apparent bearings of radio transmitting stations. This report gives the results of observations carried out by Dr. Smith-Rose between November 1922 and March 1924 on ship and shore transmitting stations. (Department of Scientific and Industrial Research: Radio Research. Special Report No. 4: Variations of Apparent Bearings of Radio Transmitting Stations. Part 3: Observations on Ship and Shore Transmitting Stations, November 1922-March 1924. London: H.M. Stationery Office, 1926. 2*s.* 6*d.* net.) The previous report describes observations using wave-lengths varying from 2000 to 9000 metres. In the experiments now described, special attention was given to a wave-length of 450 metres as this was the length in general use for every day direction finding during this period. Two land stations were mainly used for the test, the Admiralty station at Orford on the east coast of England and the Radio Research Board's station at Slough. Tests were also made on board ship. It was observed that with the short wave-length of 450 metres there was a tendency for the occurrence of 'blurred' minima which annoy observers. From the point of view of navigation an important result was proved. It was found that the existence of fog had little or no effect in producing errors. On one occasion in particular, although the fog was spread over Great Britain and a large portion of western Europe, yet the directional effects showed only the usual day and night variations. As it is chiefly during foggy weather that direction finding stations are called into action, this result is most satisfactory. Again, when the weather was cloudy and overcast, no special phenomena were noticed. It seems probable therefore that the cause of the variations is not due to any effects produced by solar radiation on the lower strata of the earth's atmosphere. The report concludes by reference to two recent papers communicated by the author and Mr. Barfield to the Royal Society. In one of these a direct determination of the effective conductivity of the earth is made at radio frequencies. This result is of importance in the general study of wave propagation. In the other and later paper, it is stated that some of the radio waves have travelled through the upper regions of the earth's atmosphere before reaching the detector.

Translucency of Porcelains.—With the view of the improvement of the ceramic industry in the United States, an investigation of the causes of translucency has been carried out by Messrs. C. W. Parmelee, professor of ceramic engineering, and P. W. Ketchum, research assistant in the University of Illinois, and the results are given in Bulletin 154 of the Engineering Experimental Station. The measurements of translucency were made by eye with the aid of a Lummer-Brodhun photometer or by the use of a photo-electric cell, the current from which when illuminated was measured by the change of deflexion of an electrometer. The two methods give relative values in fair agreement with each other, although owing to the reddish colour of the transmitted light the absolute value of the translucency by the cell method is less than that obtained by photometer. Increase of thickness of the specimen decreases the transmitted light in the usual exponential way. High felspar content produces high translucency, while flint has a less marked effect in the same direction. High clay content diminishes translucency. Fine grinding of the constituents raises the translucency in a striking way, and increase of firing temperature produces a further improvement.

Studies in Eugenics and Human Heredity in South Africa.[1]

THESE two papers by Dr. Fantham are welcome evidence of the earnestness with which he is pressing home the social applications of biology in the country in which his lot is cast. Whilst they reiterate to a large extent principles that are well known to readers of NATURE, these principles are exemplified by some interesting original observations made by Dr. Fantham since he began residence in South Africa.

The ultimate aim of zoological science is of course a thorough knowledge of the inner nature of animal life. The intense interest of this aim provides the spur which urges to zoological research in old countries like Great Britain, in which Nature has been thoroughly dominated and tamed, and in which we have to be up and doing if any traces of really wild Nature are to be allowed to persist. But in newer countries like the outlying portions of the British Empire the battle with circumambient wild Nature is at its height, and the ultimate victory is by no means assured, and so the light which zoology (and other sciences) can throw on the conditions which are likely to lead to success in this struggle contitutes their main passport to popular favour.

Now there are two main problems for eugenists which emerge from the study of human heredity; one of these may be described as the problem of the Mendelian recessive; this problem is ubiquitous, and it is this question which especially faces social workers in Great Britain. The other is the problem of the crossing of different races: this, usually denominated miscegenation, is the really burning question in countries like South Africa and the United States of America. It would constitute a problem in Australia, also, had not the Australians adopted one particular solution of it which certainly is effective so long as it is maintained, but their power to maintain it for an indefinite period of time is, to say the least of it, exceedingly doubtful. It seems to us that Dr. Fantham has not kept these two problems sufficiently distinct in his mind, for we are convinced that they are entirely different in their nature The term "Mendelian recessive" is meant to denote those defective individuals, constantly turning up amongst modern civilised men, whose defective characteristics are transmitted to posterity in a way which suggests that their inheritance follows the laws of Mendel.

The defects are, however, by no means always recessive. In fact, it seems to us that the importance of the contrast between dominant and recessive characters has been greatly exaggerated by Mendelian writers. What is usually termed a 'mutation,' that is, a sudden divergence from the type, almost always shows a peculiar character which bestows on these 'mutations' a family likeness wherever they may occur. This character is a constitutional weakness as compared with the type, and the question of dominance and recessiveness is merely the question of whether the weakness is or is not sufficiently marked to make itself felt in the F_1 generation where it enters the germ from one side only of the house. These defects show themselves in external marks of the most varied kind, such as brachydactyly (the shortening of the digits accompanied by the fusion of two of the joints), polydactyly (extra toes and fingers), hæmophilia (inability of the blood to clot), night-blindness (loss of the power to see in the dusk), and, most important of all, defective development of the brain or feeble-mindedness. Dr. Fantham quotes some well-known pedigrees, but he also gives examples from his own observations of the inheritance through three generations of such defects as 'stiff fingers' (orthodactyly), permanently bent little finger, premature baldness on the crown of the head, white forelock, and supernumerary thumbs. The inheritance of this last case is very instructive, for the trait was first noted on the left hand and it appeared in the next generation on the right hand. This shows that the character was not due to a 'gene' or 'factor' which initiated an extra growth at a particular place, but to an interference with the normal processes of growth, and there is a strong suspicion that this interference was a too tightly-constricting amnion in the latest stages of development which impinged on and split the thumb rudiment into two.

The social detriment due to the breeding of the feeble-minded of course far outweighs in importance the minor detriments due to the transmission of the slighter constitutional defects. The more extreme cases are confined in asylums, but the less marked cases are at liberty and constitute the lowest stratum in society. They have just sufficient intelligence to secure intermittent employment in the least skilled occupations, though they are in frequent need of poor law relief; they often marry improvidently and reproduce recklessly, for they have no foresight or control of their passions. They give birth to numerous illegitimate offspring, and their children inherit their defects In former times these children, defective in nature and badly cared for, died like flies; now modern philanthropy steps in to preserve them, they increase in numbers, contaminate the race, and are a danger to future generations. Dr. Fantham relies implicitly on this point on the results of the American workers Davenport and Goddard, Estabrook and others Whilst these results in broad outline will doubtless prove to be correct, it is fair to add that they have been severely criticised. Feeble-mindedness is not a definite thing due to a 'factor'; it is a varying grade of germ-damage the origin of which is due to definite causes which ought to be more closely investigated. It is instructive to note that Tredgold has found that feeble-mindedness in a given generation is often preceded in the parental generation by milder symptoms such as epilepsy or even merely nervous instability.

Turning now to the question of miscegenation, we find that the hybrids between two different races such as the Kaffir and the Dutch show no evidence of clear and sharp segregation such as is found when a mutation is crossed with the type. These hybrids show combinations of the qualities of the parental races in every conceivable proportion, but the attempt to analyse these qualities into factors, when pushed into details, reveals itself as impossible, as we have previously pointed out in the pages of NATURE. The qualities of races are acquisitions won in the struggle with the environment, and they constitute an epitome of the evolutionary history of the race. Dr. Fantham points out that the negro race, left to itself, shows no tendency to produce a civilisation or indeed to undergo any progressive evolution whatever: that it is deficient in foresight and providence, and exhibits lack of persistence and initiative. The negro is in fact a tropical animal, evolved amidst the teeming life of the warmer and more fertile zones of the earth's surface; clothing is a superfluity, and the means to satisfy hunger are comparatively easily procured, and his qualities correspond with this environment. The Dutch and English are offshoots of the white Nordic

[1] "Heredity in Man: Its Importance both Biologically and Educationally," and "Some Factors in Eugenics, together with Notes in some South African Cases." By Prof. H. B. Fantham, University of Witwatersrand, Johannesburg. *South African Journal of Science*, vol. 21, 1924, and vol. 22, 1925.

race, which grew up under the cloudy skies and cold raw climate of the shores of the North Sea in post-glacial times. The members of this race had to develop boldness and perseverance to survive at all, and they won their food as a result of terrific struggles with the elements, and to this struggle they owe their good and forceful qualities. Dr. Fantham points out that hybrids between the two races lose the admirable qualities of the white and yet are not controlled by the tribal conventions of the negro. Further, as children of the same family differ in the colour of their skins, the whiter consider themselves European and despise their darker brothers and sisters as negroes. Dr. Fantham traced one such hybrid family through five generations. A joint meeting of the Eugenic and Anthropological Societies of London was told last spring that miscegenation was far more widespread than one would gather from Dr. Fantham's papers, and was slowly undermining the moral stamina of the whole of the white population of South Africa. What are known as 'coloured people,' that is, hybrids of the second and third generation, are increasing in number, and the whiter individuals are intermarrying freely with the pure white population. We can only say that we trust that this view is an exaggerated one.

Dr. Fantham alludes to another matter of great importance, namely, the exhausting and weakening results of too frequent pregnancies not only on the mother but also on the children. We ourselves believe that the most fertile cause of human 'mutations' is to be found here. Dr. Fantham gives an example of the results of such pregnancies traced through three generations. In all three 'Mongolian idiots' appeared; this defect appears to be due to amniotic pressure on the developing brain.

Dr. Fantham's final conclusion is one which we can heartily endorse; it is that "the principles of animal [including human] biology put forward in simple interesting language and illustrated by living examples should form an essential short course in the curriculum of every University student as well as of every school child." This proposal has been pressed on our own Ministry of Education by the Council of the Eugenics Education Society, and when population and cognate problems in Great Britain become sufficiently acute to cause widespread discomfort, it will doubtless be given official attention. E. W. M.

Research in Illumination.

A SURVEY of the work of the Illumination Research Committee of the Department of Scientific and Industrial Research is given in a report issued recently by the Department. These investigations were also reviewed in a paper read by Mr. J. W. T. Walsh before the Illuminating Engineering Society on June 1. In the introduction to the Report the events leading to the formation of this committee are recalled, and attention is directed to the demand for information on lighting matters that has arisen since the formation of the Illuminating Engineering Society in 1909. On the Illumination Research Committee the medical and architectural professions are represented, and there are several members who are experts on illumination and also members of the Illuminating Engineering Society, the various British Engineering Standards Association committees, and other bodies concerned in research on illumination. Co-ordination of effort is thus facilitated and overlapping of work avoided.

The representation of the Medical Research Council on the committee is of special importance, as numerous problems before the committee have a physiological basis. This applies particularly to the study of 'glare,' and of the relation between intensity of illumination and speed and accuracy of fine work. Such fundamental researches necessarily require time. In connexion with the second problem, attention has first been devoted to printing as an example of 'fine work' readily adapted to investigations of relations between illumination and output. In this investigation valuable aid has been rendered by the Joint Industrial Council for the Printing Trades of the United Kingdom. The results are to be presented in a detailed report, but it appears that the relation between illumination and quality of work has been fully substantiated. This investigation will be extended to other forms of 'fine work.'

Other fundamental researches include a comprehensive record of daylight-intensities, now being made at the National Physical Laboratory, Teddington.

Among the 'special problems of urgency' may be mentioned the investigations of enamelled iron reflectors, which have contributed greatly to the framing of the recent British Engineering Standards Association's specification for reflectors used in industrial lighting. The design of picture galleries with the view of the avoidance of troublesome reflections in the glazed surfaces of pictures has also been studied. Another series of researches deals with the effect of flickering illumination on vision and the brightness of glassware used in various lighting fittings (the latter another problem with which a B.E.S.A. committee is concerned). A series of experiments is in progress with the object of studying the effect of colour and distribution on the degree of comfortable illumination required for clerical work. The systems examined include: (*a*) Semi-indirect lighting with vacuum lamps; (*b*) Semi-indirect lighting with artificial daylight (blue bulb) lamps; (*c*) Artificial window lighting with vacuum lamps; and (*d*) Artificial window lighting with artificial daylight lamps. Numerous other investigations include the examination of transmission of light through window-glass, the effect of window size and the reflecting power of walls and ceilings, the relation between glare and visibility in street lighting, and the distribution of temperature in the glass and other parts of lighting fittings.

Mr. Walsh, in the concluding portion of his paper, mentioned that these investigations would be the subject of individual reports, to be issued by the Department in the near future. At the meeting on June 1, general recognition of the importance of the work being done by the committee was expressed. Mr. C. C. Paterson (chairman of the Illumination Research Committee), in opening the discussion, alluded to the services rendered by the Illuminating Engineering Society and its hon. secretary (Mr. L. Gaster) in paving the way for the creation of the committee and initiating these researches. Sir John Herbert Parsons, who presided, emphasised the important field presented for physiological study by artificial lighting, and commended the subject to the notice of ophthalmologists. Miss Wiggins mentioned examples of the valuable aid which the committee has rendered to the British Engineering Standards Association in connexion with its various investigations. Mr. J. S. Dow, in commenting on the relation between illumination and ease of work, pointed out that discretion is necessary in attempting to derive standards on the basis of natural illumination, and suggested that investigations should be directed to the effect on vision of the differences in the spectra of artificial illuminants and daylight. Mr. W. C.

Raffé suggested various inquiries bearing on the effect of colour, and the influence of light on certain metals. Mr. A. Cunnington referred to problems arising in connexion with the passage of railway trains through short tunnels, as illustrating the liability of temporary dazzling of the eyes to cause accidents. Mr. P. J. Waldram discussed the problem of avoiding troublesome reflections in picture galleries, referring particularly to the effect of badly placed skylights.

At the end of the discussion Mr. L. Gaster explained the interlinking of the Illumination Research Committee with the various other organisations interested in research on illumination, and pointed out that the Illuminating Engineering Society is performing valuable service by acting as a 'liaison officer' and as a clearing-house for information. The recent discussion before the Society of the specifications of the various B.E.S.A. committees (see NATURE, March 13, p. 397) proved valuable in making them more widely known, and it is hoped that the discussion of this preliminary report of the Illumination Research Committee would be equally useful. It is of obvious importance that reports of such work should receive the widest publicity and should be thoroughly discussed, and he hoped that the forthcoming reports on individual researches would be likewise presented at meetings of the Society for full consideration.

Primitive Time Reckoning and the Calendar.

THE stages by which the Julian calendar as a method of time reckoning was attained are demonstrated by Dr. Martin P. Nilsson in a contribution to vol. 39, pt. 6 of *Scientia*, which surveys the various methods of measuring time employed by primitive and early peoples, and shows how the conception of a continuum in time, which is the essence of a calendar, has gradually developed.

The mind of primitive man, being essentially interested in the concrete, expresses time in terms of action, such as the time it takes to cook a bowl of rice, or the duration of a journey, the double hour of the Babylonians being an example of the latter. In the early stages certain recurrent natural phenomena are regarded, not as units of time of a certain duration, but as indications of time The conception of continuity is absent at this stage. Thus time of day is indicated by the natural divisions—dawn, twilight, sunrise, or the position of the sun. Night is regarded as a whole. The crow of the cock is employed generally, but few make use of the stars as did the South American Indians and the Homeric Greeks. The conception of a 24 hours' day is late.

In the same way, the season of the year is indicated by natural phenomena, winter, summer, the season of snow, rain, drought. Neither the duration of the season nor, more remarkable, their number, is uniform. While we have four seasons, other peoples have two, three, five, or six. The unity of the year is established only slowly, and that empirically. As among the Banyankole, the reckoning may be from rains to rains. An agricultural people employs the agricultural operations, reckoning from sowing to harvest, the vacant period following the latter not counting.

The year is recorded and identified by some striking happening such as the "year of the meteorites." The Roman method of identifying it by the Consuls is another example.

The observation of the stars and constellations, and especially their heliacal rising, gives a more exact method of time reckoning. These observations are brought into relation with agricultural operations. This leads to the observation of the solar year, which in Egypt was fixed so far back as the prehistoric period through observation of the heliacal rising of Sirius; but the conception of units of time and time as a continuum arose from observation of the moon's phases, which gave the lunar month and the divisions of the lunar month as a record of time within the month. These months were named from the appropriate activities or natural phenomena. Owing to the disparity of the lunar month and the solar year in this luni-solar year, which was known to the Greeks, Babylonians, and Jews, it became necessary, whether the cycle consisted of 12 or 13 lunar months, to employ the principle of inter- or extra-calation, either at irregular intervals or periodically, as was done in Greece in the 7th century B.C. It was this last type of calendar which was superseded by Cæsar's reform, which based the Julian calendar solely on the solar year, recognising the impossibility of equating it with the lunar year.

The Need for Precision in Botanical Terminology.

IN his presidential address to the Linnean Society on May 27, Dr. A. B. Rendle referred to the work of the Society during the year. An interesting feature of certain of the discussions has been the tendency to get back to first principles or definitions and to discover that that which we had regarded as definite is after all vague. For example, in one of the discussions various authorities were quoted in support of different ideas as to the conception of the term carpel. Morphological terms originate in a desire to express certain conceptions, limited or general, and morphologists are apt to find themselves in the same position as the present-day systematist in typifying species. In the matter of definitions a meaning may be attached to a term which the originator never meant to convey; moreover, a vague use of terms may engender vague ideas of relationship. The advisability of the inclusion of the seed-like organs of Pteridosperms under the definition of seeds was also questioned. What is the degree of importance of the differences between the modern seed, which has priority for the use of the term, and the organ characteristic of Pteridosperms? Has the latter advanced beyond the gametophyte stage? Does the fact that postponement of embryo-formation until after the freeing of the seed occurs, for example in Cycads, meet the objection? This absence of an embryo may be called negative evidence; but is it not rather the absence of the criterion of the normal seed, which is an arrangement for the protection of the new sporophyte during a period of rest or transport? The phases in the life-history preceding and accompanying germination must have been widely different in the two great groups.

Until the Caytoniales were described we were clear as to what we understood by Angiosperms. We know nothing of the contents of the seed-like bodies in this primitive group, but we recognise the Angiosperm idea and associated with it the generally considered advanced character of wind-pollination.

Are we clear as to our ideas of what constitutes a Gymnosperm? The tendency is to include here

everything with a seed or seed-like structure which is not angiospermic; that is, everything from Pteridosperms to Conifers—an aggregate of widely differing groups. We are in danger of introducing merely a physiological or biological character into our systematics and of recognising a mixed group which is not comparable with the well-defined group of Angiosperms.

The relationship of Monocotyledons to Dicotyledons has been the subject of many discussions in recent years. Henslow derived Monocotyledons from Dicotyledons as a result of adaptation to an aquatic habit, and Miss Sargent similarly derived them, but looked to the geophytic habit for the explanation. Neither view will withstand criticism, and it is more in accordance with our present knowledge to admit that there is no evidence of the derivation of one from the other. The problem of the origin of these two great subdivisions of Angiosperms, like that of the Angiosperms themselves, and even of modern seed-plants, still awaits solution. We need more spade-work and more facts before we are able satisfactorily to solve these problems of phylogeny.

University and Educational Intelligence.

ABERDEEN.—At the summer graduation the honorary degree of LL.D. was conferred, among others, on Prof. F. W. Oliver and Prof. T. B. Wood.

The degree of D.Sc. has been conferred on J. E. Humphries for a thesis on "Studies in Phenylhydrazones."

CAMBRIDGE.—The Frank Smart Prizes for botany and zoology have been awarded to D. J. Watson, Downing College, and to H P. Hutchinson, St. John's College, respectively. At King's College, E T. S. Appleyard, G. P. Hudson, and J M. Stephens have been elected to research studentships.

MANCHESTER.—On July 8, on the occasion of his retirement from the Beyer chair of zoology in the Victoria University, Prof. Sydney J. Hickson was presented with a cheque by Sir William Boyd Dawkins, on behalf of a number of his former students, colleagues, and friends. In eloquent terms Sir William Boyd Dawkins referred to Prof Hickson's services to science, to the work which he has done for the University, and for the cause of education in natural science. A dinner has been arranged in his honour at the University Refectory on Friday, October 29, when his friends will have an opportunity of meeting him.

MR. GEORGE PATCHIN has been appointed Principal of the Sir John Cass Technical Institute in succession to Dr. C. A. Keane, who has retired.

MR. P. L. ROBINSON, lecturer in chemistry in Armstrong College, Newcastle-upon-Tyne, University of Durham, has been awarded the degree of D.Sc. in the University of Durham for a thesis entitled "A Comparison of the Atomic Weights of Silicon from Various Sources."

ON Thursday, July 8, H R.H The Prince of Wales visited Merchant Taylors' School to lay the foundation stone of a new science building on the north side of the School quadrangle and opposite the opening from Charterhouse Square. The Prince referred to the long and illustrious history of the School and to the great munificence of the Merchant Taylors' Company in fostering its many activities. After the ceremony, Mr. G. N. Pingriff (chief mathematical and science master), Mr. L. H. Hutton (chief modern languages master), and three senior boys were presented to the Prince. The new building will provide for a very complete extension of the science teaching. The old science block contains an exceptionally well equipped, though somewhat cramped, physics laboratory as well as a rather old-fashioned chemical laboratory and biological department. The new building will comprise, on the ground-floor, a large lecture room, a preparation room, and a laboratory workshop; on the first floor, a good laboratory for mechanics and elementary science, as well as a form-room for the 'Special' Fifth; and on the second floor, a new biological department consisting of laboratory and museum. This will enable the old building to be devoted almost exclusively to chemistry and more advanced physics, but the 'Special' Sixth form-room will remain here. Provision will be made for the projection of kinematograph films and a complete electrical installation consisting of an ordinary alternating current lighting circuit, a power circuit for heating and motors, and a 24-volt direct-current circuit for electrolytic and other work.

MANCHESTER was the earliest of the modern universities successfully to adopt the idea of residential halls, and the oldest of these, Dalton Hall, was founded by the Society of Friends in Manchester in 1876, being named after John Dalton, for forty years a prominent Manchester citizen and member of the Friends' Meeting. On July 9 a jubilee dinner was held at the Hall, at which was present a large and distinguished company. The toast of Dalton Hall was proposed by Sir William Boyd Dawkins, who paid a warm tribute to the part played by the institution in the general educational system of Manchester and the breadth of view which inspired its founders and had characterised its life In the great work accomplished by the University, the Society of Friends has rendered inestimable service They had introduced into Manchester a non-sectarian spirit and a sturdy uprightness the value of which was incalculable. Two old Principals of the Hall were present as well as the present Principal, Mr. G. A. Sutherland, until recently senior lecturer in physics at University College, London, all of whom replied to the toast Reference was made to the number of eminent men of science and letters who have passed through the Hall as students. These include Prof. A. S Eddington, Dr G. C Simpson, Dr Gilbert Fowler, Prof. W. A. Bone, Prof W. B Anderson, Dr. Bevan Lean, Sir Michael Sadler, who resided at the Hall when on the University staff; Prof. J. F. Thorpe and Prof. Andrew Robertson, old Hall tutors; and Mr. W. H. Moberley, the Vice-Chancellor elect of the University. The Hall has now accommodation for 65 students and a staff of twelve tutors, most of whom hold or have held appointments on the University staff.

THE Royal Commissioners for the Exhibition of 1851 have made the following appointments to Senior Studentships and Overseas Scholarships for 1926:—*Senior Studentships:* Dr. A. J. Bradley (University of Manchester—crystallography); Dr. H. J. Emeléus (Imperial College of Science and Technology—inorganic chemistry); Mr. R. G. J Fraser (University of Aberdeen—physics and chemistry); Dr. C W. Shoppee (University of Leeds—organic chemistry); Mr. W. L. Webster (University of Cambridge—physics). *Overseas Scholarships:* Mr. R. C. Robb (Dalhousie University, Halifax, Nova Scotia—biology); Mr. F. H. Yorston (McGill University, Montreal—organic chemistry); Mr. H. M. Cave (Queen's University, Kingston, Ontario—physics); Mr. J. R. Vickery (University of Melbourne—bio-chemistry); Mr. F. P. Bowden (University of Tasmania—physics); Mr. E. R. Roux (University of the Witwatersrand—botany); Mr. R. R. Nimmo (University of New Zealand—physics).

Contemporary Birthdays.

July 16, 1872. Capt. Roald Amundsen.
July 18, 1853. Prof. H. A. Lorentz, For. Mem. R.S.
July 21, 1873. Sir Walter Morley Fletcher, K.B.E., F.R.S.
July 21, 1873. Prof. Howard T. Barnes, F.R.S.
July 22, 1865. Sir Richard Redmayne, K.C.B.
July 24, 1856. M. Charles Émile Picard, For. Mem. R.S.
July 24, 1853. M. Henri A. Deslandres, For. Mem. R.S.
July 25, 1854. Mr. Alfred Barnard Basset, F.R.S.

Prof. LORENTZ, an alumnus of the University of Leyden, was born at Arnheim. He was elected to the chair of theoretical physics in that University in 1875, and among his former pupils was Prof. Zeeman. The Nobel prize in physics was allotted to both of them in 1902. Rumford medallist of the Royal Society in 1908, Prof. Lorentz was awarded the Copley medal in 1918. While his researches as a mathematical physicist of the first order have covered many fields of investigation, his principal work has dealt with the theory of electrons and the constitution of matter considered as an electrodynamic problem.

Sir WALTER FLETCHER, who was born at Liverpool, is a graduate of Trinity College, Cambridge. He is Secretary of the Medical Research Council.

Prof. HOWARD T. BARNES was born at Woburn, Mass., and educated at Montreal Academy and McGill University. Originally a demonstrator in the chemistry department of McGill, he became in 1908 Macdonald professor of physics there, and, soon after, director of the Physics Building. For long he was ice engineer of the Hydro-Electrical Power Commission of Ontario. Prof. Barnes invented the micro-thermometer ice preventive method. He has written many memoirs concerning ice formation, specific heats, and radioactivity.

Sir RICHARD REDMAYNE, consulting mining engineer, was born at Gateshead-upon-Tyne. Following private tuition he attended Durham College of Science, and afterwards he became a mining apprentice at Hetton Collieries. Sir Richard was H.M. Chief Inspector of Mines, 1908–20. A member of many Royal Commissions on mining operations, he has been responsible in the main for the respective official reports. Sir Richard is a chevalier of the Legion of Honour.

M. PICARD, eminent as a mathematician, was born in Paris and educated there at the École Normale Supérieure. From 1879 until 1881 he held a professorial chair in the University of Toulouse. One of the permanent secretaries of the Paris Academy of Sciences, he is a commander of the Legion of Honour. M. Picard is an honorary member of the Royal Society of Edinburgh.

M. DESLANDRES, the distinguished director of the Astronomical and Physical Observatory at Meudon, was born in Paris and educated at the École Polytechnique. An active member of the International Astronomical Union, M. Deslandres is an officer of the Legion of Honour. He has many written memoirs on general and physical astronomy.

Mr. BASSET, a Londoner, graduated at Trinity College, Cambridge, as 13th wrangler. He is the author of a treatise on physical optics, and other works.

Societies and Academies.

LONDON.

Mineralogical Society, June 15.—S. I. **Tomkeieff**: On some chloritic minerals associated with the basaltic Carboniferous rocks of Derbyshire. Certain leptochlorites occurring as vesicular infillings in the Carboniferous lavas ('toadstones') of the North Derbyshire area are described. The chemical analysis of a finely spherulitic chlorite from Calton Hill places it definitely in the delessite-diabantite series. Some other chlorites from Miller's Dale are less crystalline and show a peculiar development of bacteria-like aggregates, similar to those observed in the chlorophæite of Dalmahoy Hill, near Edinburgh. All these chlorites can be compared with the chloritic palagonite occurring in the mesostasis of the non-vesicular basalt of the same lava flow, and it is suggested that both varieties of chlorite are primary, and were formed during the final stages of the solidification of the magma (autopneumatolitic).—F. L. **Stillwell**: On the nature of berthierite. A chemical analysis of berthierite from Nullamanna, near Inverell, New South Wales, gave the formula $3FeS . 4Sb_2S_3$. Microscopical examination of polished and etched sections of the material shows an intergrowth of about 18 per cent. of stibnite. Deducting this from the results of the chemical analysis, the formula of berthierite becomes $FeS . Sb_2S_3$.—L. J. **Spencer**: A sperrylite crystal from the Transvaal. Crystals of sperrylite (the rare platinum arsenide, $PtAs_2$) up to half-an inch across have recently been found in the Potgietersrust platinum fields, Transvaal. The crystal examined measures 5·0-5·5 mm. across and weighs 1·294 gm. It is a brilliant cubo-octahedron developed on all sides and with the corners and edges much rounded. The rounded areas give a profusion of scattered reflected images, few of which lie in the principal zones on the crystal. The only forms identified with certainty are (100), (111), (110), (210), (211).—H. E. **Buckley**: The anomalous optical properties of some new series of isomorphous double tartrates. In addition to the mixed crystals $\{m\ NaK,\ n\ Na(NH_4)\}\ C_4H_4O_6 . 4H_2O$, previously examined, optical anomalies of the same kind have now been determined for the series $\{m\ KNa,\ n\ K(NH_4)\}\ C_4H_4O_6\ 4H_2O$ and $\{m\ (NH_4)Na,\ n\ (NH_4)K\}\ C_4H_4O_6 . 4H_2O$ All these crystals are orthorhombic and isomorphous, but when freshly prepared they show crossed dispersion characteristic of monoclinic crystals (borax type). On standing, the crystals show a slow change in the size of the optic axial angles and in the position of the optic axial planes for different colours; and finally, after a lapse of some time, they settle down with all the optic axial planes lying in the plane (100) or (010) or in both, giving in the latter case crossed axial-plane dispersion of the orthorhombic (brookite) type. This change is hastened by rise in temperature and retarded by pressure. Sections from the outer and inner portions of the crystals showed a difference, evidently due to the time taken for growth; but in the final state they are identical, suggesting that the crystals are homogeneous. Other isomorphous series of mixed crystals containing only two of the three bases, namely $\{m\ Na_2,\ n\ Na(NH_4)\}$, $\{m\ (NH_4)_2,\ n\ (NH_4)Na\}$, $\{m\ Na_2,\ n\ NaK\}$, and $\{m\ K_2,\ n\ KNa\}$, showed, in the range of the visible spectrum, the optic axial planes all in one plane, but with wide differences in optic axial angle.—G. T. **Prior**: On the South African meteorites, Vaalbult, Witklip, and Queen's Mercy. The Vaalbult meteoric iron is a very deeply and broadly pitted mass weighing about

26 lb. which was found on a farm in the Prieska Division, Cape Province. It is a coarse octahedrite having a percentage of nickel of about ·7. The Witklip meteoric stone fell on May 26, 1918, at about 9.40 A.M., after the appearance of a luminous meteor and loud explosions, on the farm Witklip in the Carolina District, Transvaal. Fragments weighing together only about 22 gm. appear to have been preserved. It is a grey chondrite closely resembling the Cronstad meteoric stone. Of the Queen's Mercy meteorite a large stone, a foot and a half long, fell, on April 30, 1925, at Queen's Mercy, about twenty miles from Matatiele, and was broken into small pieces by the natives. A second complete smaller stone, weighing about 950 gm., which fell about fifteen miles from Matatiele, was obtained from Chief Jeremiah Moshesh and is now in the Natal Museum at Pietermaritzburg. The meteorite is a veined grey bronzite-chondrite containing about 15·5 per cent. of nickel-iron, in which the ratio of iron to nickel is about 10·5, and about 5·5 per cent. troilite, and having a ratio of magnesia to ferrous oxide in the pyroxene of about 5.

Royal Meteorological Society, June 16.—J. E. **Clark**, I. D. **Margary** and R. **Marshall**: Report on the phenological observations in the British Isles, 1925. This year illustrated strikingly how easily extreme conditions may cancel out each other if the year is taken as a whole. December 1924 and November 1925 stand out, one as the mildest for many years, the other among the coldest. May gave extremes of warmth and cold and was very wet. June drought and heat were extreme. Yet the year was exactly normal in temperature, and so too the mean date of flowering. Migrants were only a day late. The tree fruit was doubly hit. Early blooming after the warm winter exposed it to the inclemency of late April and May, while the June drought was fatal to young fruit set badly, and also to later-sown crops. Hay, early sown grain, roots including potatoes, did pretty well where weather permitted fair harvesting, but sunshine after mid-July was lacking. Normal plant progress was uneven in various districts, lines of equal unseasonableness showing some districts very early, others as much late. The spread over the British Isles of the cuckoo compared to the swallow shows that passing westward to Ireland from S.E. England its lag behind increases from two to ten days. But northwards to Berwick it loses only three days and then begins to catch up, finally reaching north Scotland a day early on the average of thirty-five years. Twelve organisations are now collaborating in Europe, extending north to Scandinavia, south to Italy, and east to Russia.—S. Morris **Bower**: Report on winter thunderstorms in the British Islands, Jan. 1 to Mar. 31, 1925. February was the stormiest month in England and Wales, while January was most disturbed in Scotland and Ireland. For England and Wales the stormiest areas were mainly on or near the south coast, the southern parts of Sussex and Surrey being heavily visited.—Edward **Kidson**: Abnormal rates of ascent of pilot balloons in the lower levels of the atmosphere at Melbourne. Observations extending from 1922 until 1925 are discussed, and tables given showing respectively (1) rapid ascending currents in the atmosphere, and (2) low rates of ascent. Rapid ascending currents and low rates of ascent most frequently occur in the months of September to February inclusive, that is, in the months when the land is warmer than the air and sea. The rapid ascending currents are encountered with the greatest relative frequency at 11.00 hr. and the least at 9.30 hr. With the low rates of ascent the greatest and least relative frequencies are at the same hours. The low rates of ascent seem to be largely the product of turbulence, the balloon being caught in the ascending portions of eddy currents.

Royal Anthropological Institute, June 22.—V. Gordon **Childe**: The first colonisation of Central Europe. The first food-producing civilisation was introduced into Belgium and northern France through the gradual spread of Danubian cultivators. These may be traced back to Moravia, and it is clear that in their migration they lost elements of culture. The origin of their civilisation must be sought farther south, immediately in 'Hungary,' though not on the Danube-Tisza plain, which in the warm, wet, early neolithic period would have been uninhabitable. On the loess terraces of Serbia and the Banat a rich civilisation has been discovered from which the Moravian might be derived by degradation. The sites are located where open ridges of loess are cut by the Danube or the Tizsa, just where people coming up the Danube would be likely to halt, and often in the vicinity of ores or on auriferous streams. The remains, notably remarkable clay statuettes, and the costume these illustrate, suggest that their makers came up the river bringing with them elements of Ægean and Egyptian civilisation. In the formation of Danubian civilisation, survivals of palæolithic elements and influences from the vase-painters of Transylvania can be detected, and its spread may ultimately have been accelerated by the pressure of nomadic steppe-folk from south Russia.

PARIS.

Academy of Sciences, June 7.—L. **Lecornu**: The problem of the grindstone.—Léon **Guillet**: The tempering of lead-antimony, lead-tin, and lead-antimony-tin alloys. Referring to the recent work of Dean, Zicheick and Nix on the tempering properties of white-metal alloys, the author directs attention to earlier work by Dubosc and by himself on the same subject.—Léon **Guillet**: The cementation of copper, nickel and their alloys by tin. The cementation was produced by heating with a bronze powder (tin 25 per cent.), and results are given for copper, nickel and some alloys. The thickness of the cementation layer varied considerably, 1 mm. being the maximum. The object of the work was to produce a surface with low friction with the minimum proportion of tin.—Victor **Grignard** was elected a non-resident member in succession to the late W. Kilian.—Michel **Petrovitch**: A remarkable property of a series of double integrals.—A. **Véronnet**: Extension of the vectorial calculus to analysis and to the absolute differential calculus.— — **Noaillon**: The determination without ambiguity of the solution of the problem of Dirichlet for functions capable of summation.—Mlle. N. **Bary** and D. **Menchoff**: The integral of Lebesgue-Stieltjes and absolutely continuous functions of absolutely continuous functions.—Henry **Bénard**: The frequency laws of detached alternating vortices behind an obstacle.—P. **Dumanois**: The possibility of realising high compressions without antidetonants. By a modification of the shape of the piston of an internal combustion engine it has proved possible to obtain the same results as were obtained by the introduction of lead tetraethyl into the petrol. The comparisons were made in a car on the road.—Th. de **Donder**: The application of relativity to atomic and molecular systems.—R. **Chambaud**: A particular class of solutions of the problem of the circular ring. Application to the theory of thick circular arches.—M. **Samsoen**: The expansion of commercial glasses. Seventeen kinds

of glass were prepared, cast into rods, and the coefficients of expansion measured with the Chevenard differential dilatometer. The complexity of the problem prevents any theoretical conclusions being safely drawn from the data obtained. It was found, however, that the additive rule of Winkelmann and Schott is not valid.—Salomon **Rosenblum**: α-rays with single charge.— — **Chevenard**: The course of the isotherms representing the resistance and thermo-electric power of the reversible ferro-nickels in the interval $-200°$ C. to $1000°$ C. The experimental results, shown in diagram form, do not clearly indicate the existence of the compound Fe_2Ni, but are not definitely opposed to the possibility of its existence. Further experiments at temperatures between $-195°$ C. and the absolute zero are required.—T. **Karantassis**: Double decompositions between the halogenides of phosphorus, tin, arsenic, antimony, lead, bismuth, silicon, titanium, zirconium and thorium. From the experiments described the conclusion is drawn that in the trivalent metalloid group the iodide of an element of low atomic weight exchanges its iodine for chlorine or bromine from the halogenide of an element of higher atomic weight.—N. **Maxim**: The action of the organo-magnesium compounds on some aromatic dialkylamides.—Em. de **Martonne**: Dryness and the index of aridity.—**Jacquet**: New radioactive springs in the Puy-de-Dôme.—L. **Eblé**: Magnetic measurements in the north-east of France.—Aug. **Chevalier**: The cinchonas of tropical Africa.—Mlle. G. **Bonne**: The constitution of the gynæceum in the Chrysobalaneæ.—X. **Chahovitch**: The energy metabolism in the course of experimental scurvy. Study of the metabolic quotient. It is suggested that the increase in the basic metabolism in experimental scurvy may be due to increased secretions of the suprarenal capsules and of the thyroid gland.—Mme. L. **Randoin** and R. **Lecoq**: The inequality of the proportion of water-soluble vitamins (B) in yeast extracts of different origin. It is generally accepted that yeasts and yeast extracts are substances exceptionally rich in the water soluble vitamins. Experiments on pigeons are described which prove that all yeast extracts have not the same biological value. An extract from beer yeast appeared to contain two factors, one securing the maintenance of the animal, the other essentially curative as regards polyneuritis. On the other hand, an extract of distillery yeast contained only the first factor and, tested biologically, was markedly inferior to the extract of beer yeast.—Claude **Fromageot**: The oxidation of pyruvic acid by ceric ions. On oxidation of pyruvic acid with ceric salts the solution containing the enol form behaved differently from that containing the keto form, the former taking up more oxygen. The enol form is more rapidly oxidised than the keto form.—Raymond **Petit**: The action of a solution of basic chlorhydrate of quinine and of urethane on the blood.—Henri **Marcelet**: Studies of the oils extracted from the head of a dolphin (*Delphinus Delphis*). Oils extracted from the maxillary glands, from the nose, and from the fat surrounding the skull were submitted to complete physical and chemical examination. Large differences were observed, showing that earlier analyses of oil described as dolphin head oil must give misleading figures.—H. **Barthelemy**: The influence of the dilution of the sperm on the duration of survival of the spermatozoids of *Rana fusca* in aqueous or saline media.—Ch. **Porcher**: The alteration of the micelles of the caseinate in the calcium caseinate—calcium phosphate complex and its consequences in the action of rennet on this complex.— — **Boulard**: A method permitting fermentations to be arrested at will, especially liquids containing sugar and alcohol, and rendering these unfermentable. The method is based on the fact that a second culture does not develop in a medium which has previously served for the cultivation of the same ferment. The method is capable of industrial applications.—E. **Lesné** and S. **Simon**: New observations on the anti-rickets factor of cod-liver oil. Vegetable oils neither prevent nor cure experimental rickets, whereas certain cod-liver oils both prevent and cure. It is shown that whilst certain oils are more or less active, others are absolutely inert, even although the latter fulfil all the requirements of the Codex. It is suggested that these results prove the necessity for a biological test of cod-liver oil.—A. **Nanta**: A myxobacterial splenomegaly.—P. E. **Pinoy**: A syn-bacterium isolated from cases of splenomegaly.

ROME.

Royal National Academy of the Lincei, May 2.—P. **Burgatti**: Elastic distortions.—U. **Cisotti**: Dynamic effects of a fluid circulating between any number of thin cylinders with parallel axes.—Ferruccio **Zambonini** and Luca **Coniglio**: The presence of marked proportions of cæsium compounds in certain products of the present-day activity of Vesuvius.—M. **Cantone**: Reply to a criticism. Bemporad's criticism of the author's communication on a new method of studying experimental results.—Achille **Russo**: Absence of agamous period and individual development in *Cryptochilum echini* Maupas.—Luigi **Fantappiè**: Non-linear analytical functionals.—Francesco **Tricomi**: Inversion formula of the order of two double integrals "with asterisk."—Vladimiro **Bernstein**: Singularity of interpolar functions satisfying certain asymptotic conditions.—E. **Cartan**: Riemann's spaces in which transport by parallelism maintains the curvature.—G. **Vranceanu**: A class of anolonomous systems.—U. **Bordoni**: The transmission of heat by radiation.—F. **Persico**: Magnetic rotatory polarisation in an alternating field. The rotatory polarisation of light in an alternating magnetic field follows the variations in the field almost exactly.—Giorgio **Piccardi**: The affinity of the neutral bromine atom for the electron.

VIENNA.

Academy of Sciences, May 20.—F. **Schuster**: On vapour pressure curves.—A. **Wegener**: Observations of the twilight arch and of the zodiacal light in Greenland.—Z. **Dische** and D. **Lazlo**: The influence of carcinoma on the glycolysis of organs, especially liver and kidney.—F. **Heritsch**: The "window" of Fischbach, a vault of Semmering rocks, limestone and quartzite under the massive gneiss.—H. **Handel-Mazzetti**: New Chinese plants (fortieth and last communication), including 12 species of Gentiana.

Official Publications Received.

Conseil Permanent International pour l'Exploration de la Mer. Rapports et Procès-verbaux des Réunions, Vol. 39: Report of the North-Western Area Committee for 1924 and 1925 (Rapport Atlantique, Secteur Nord-Ouest, 1924-1925). By Prof. Johs. Schmidt. Pp. 168. Publications de Circonstance, No. 91: On a New Repeating Current-Meter. By V. Walfrid Ekman. Pp. 27. (Copenhague: Andr. Fred. Høst et fils.)

Transactions of the Royal Society of Edinburgh. Vol. 54, Part 3, No. 11: The Anatomy of the Head of a Fœtal African Elephant, Elephas africanus (Loxodonta africana). By Dr. Nellie B. Eales. Pp. 491-551+12 plates. 12*s*. Vol. 54, Part 3, No. 12: The Old Red Sandstone of Shetland. Part 1: South-Eastern Area. By Dr. T. M. Finlay; with an Account of the Fossil Fishes of the Old Red Sandstone of the Shetland Islands, by Sir Arthur Smith Woodward and Errol Ivor White. Pp. 553-572+3 plates. 3*s*. 6*d*. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Department of the Interior: Bureau of Education. Bulletin, ——, No. 8: Recent Progress in Legal Education. By Alfred Z. Reed. Pp. 30. (Washington, D.C.: Government Printing Office.) 5 cents.

Berichte der Naturforschenden Gesellschaft zu Freiburg i. Br. Herausgegeben von Prof. Dr. J. L. Wilser. Sechsundzwanzigster Band, Erstes Heft. Pp. 120+46. (Freiburg i. Br.: Speyer und Kaerner.)

Empire Cotton Growing Corporation. Report of the Fifth Annual General Meeting. Pp. 12. (London: Millbank House, Millbank, S.W.1.)

Proceedings of the South London Entomological and Natural History Society, 1925–26. Pp. xviii+112+9 plates. (London: Hibernia Chambers, London Bridge, S.E.1.)

Cardiganshire Antiquarian Society. Transactions, Vol. 4. Pp. 95. (Aberystwyth.)

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 78. Veronicellidae from British Guiana, by H. Burrington Baker; Anatomical Notes on American Helicinidae, by H. Burrington Baker. Pp. 29-56. Some additional Faunal Remains from the Trias of York County, Pennsylvania. By H. E. Wanner. Pp. 21-28. (Philadelphia, Pa.)

Memoirs of the Department of Agriculture in India. Chemical Series, Vol. 8, No. 8: Drainage Waters at Cawnpore. By H. N. Batham. Pp. 127-152. 10 annas; 1s. Entomological Series, Vol. 9, No. 4: The Red Pumpkin Beetle, Aulacophora abdominalis, Fb., and its Control; with a Short Note on A. atripennis, Fb. By Mohammad Afzal Husain and Syed Abdullah Shah. Pp. 31-57+plates 12-14. 1 rupee; 1s. 9d. (Calcutta: Government of India Central Publication Branch.)

City of Norwich. The Report of the Castle Museum Committee to the Council, 1925. Pp. 25. (Norwich.)

Catalogue of Products illustrating the Tardenoisian and other Microlithic Industries exhibited at the Rooms of the Royal Anthropological Institute of Great Britain and Ireland, 52 Upper Bedford Place, June 8th to June 22nd, 1926. Pp. 8. (London.) 9d.

Empire Cotton Growing Corporation. Report on the Cotton-growing Industry of Nigeria, 1926. By Col. C. N. French. Pp. 48. (London: Millbank House, Millbank, S.W.1.) 2s.

Smithsonian Institution: the National Gallery of Art. Catalogue of Collections, II. By William H. Holmes. Pp. vi+118+45 plates. (Washington, D.C.: Government Printing Office.) 1.65 dollars.

Smithsonian Institution: United States National Museum. Bulletin 131: The Minerals of Idaho. By Earl V. Shannon. Pp. vii+484. (Washington, D.C.: Government Printing Office.) 75 cents.

Smithsonian Miscellaneous Collections. Vol. 77, No. 11: Music of the Tule Indians of Panama. By Frances Densmore. (Publication 2864.) Pp. 39+5 plates. Vol. 78, No. 1: Explorations and Field-Work of the Smithsonian Institution in 1925. (Publication 2865.) Pp. iii+132. (Washington, D.C.: Smithsonian Institution.)

United States Department of Agriculture. Department Circular No. 363: The Japanese Beetle. By Loren B. Smith and Charles H. Hadley. Pp. 66. 25 cents. Department Circular No. 380: Calcium Cyanide as a Fumigant for Ornamental Greenhouse Plants. By C. A. Weigel. Pp. 16. 5 cents. Farmers' Bulletin No. 1461: The Common Cabbage Worm and its Control. By F. H. Chittenden. Pp. ii+14. 5 cents. Farmers' Bulletin No. 1462: The Potato Leafhopper and How to Control it. By J. E. Dudley, Jr. Pp. ii+12. 5 cents. Farmers' Bulletin No. 1472: Preventing Damage by Termites or White Ants. By T. E. Snyder. Pp. ii+22. 5 cents. Department Bulletin No. 1364: Effects on Honeybees of Spraying Fruit Trees with Arsenicals. By N. E. McIndoo and G. S. Demuth. Pp. 32. 5 cents. Department Bulletin No. 1369: The Cattle Grubs or Ox Warbles, their Biologies and Suggestions for Control. By F. C. Bishopp, E. W. Laake and H. M. Brundrett, and R. W. Wells. Pp. 119. 25 cents. (Washington, D.C.: Government Printing Office.)

Diary of Societies.

SATURDAY, JULY 17.

SOCIETY FOR EXPERIMENTAL BIOLOGY (in Department of Natural History, University of Edinburgh), at 10 A.M.—Dr. F. A. E. Crew: The Developmental Capon and Poulard.—E. A. Spaul: The Metamorphic Principle of the Anterior Lobe of the Pituitary.—W. P. Kennedy: Diet and Reproduction in the Rat.—Prof. J. H. Priestley: The Perception and Transmission of Stimulus in the Coleoptile of the Grass Seedling.—L. A. Harvey: The Relation of Cell Inclusions to Cell Metabolism.

MONDAY, JULY 19.

SOCIETY FOR EXPERIMENTAL BIOLOGY (at the Botanical Gardens, Edinburgh), at 10 A.M.—J. Gray: The Growth of Fish.—E. Philip Smith: The Effect of Acidity on Regeneration in Coleus.—J. W. Gregor: The Influence of Environment on the Formation of definite Habitat Types.—K. B. Blackburn: Some Observations on Sex and Chromosomes in Plants.—(In Department of Natural History, University of Edinburgh), at 2.30.—A. Walton: The Survival of Fertilising Capacity of Rabbit Spermatozoa *in vitro*.—A. D. Hobson: The Formation of the Fertilisation Membrane in *Echinus esculentus*.—E. Ponder: The Kinetics of Hæmolytic and Bacteriolytic Reactions.—T. Rettie: Demonstration of a Histological Method for the Early Stages of Cell Injury.

WEDNESDAY, JULY 21.

CORRELATIVE SCIENCE SOCIETY (at Royal Botanic Society of London, Regent's Park), at 3.—Waves and Vibrations—The Spectra of Nebulæ, of Temporary, Variable and Normal Stars.

CONFERENCES.

JULY 15 TO 19.

JOURNÉES MÉDICALES DE PARIS (at Paris).

JULY 19 TO 23.

BRITISH MEDICAL ASSOCIATION (at Nottingham).

SOCIETY OF CHEMICAL INDUSTRY (Annual Meeting) and CONGRESS OF CHEMISTS.

Monday, July 19.—Institution of Chemical Engineers (Annual Corporate Meeting) (at Central Hall, Westminster), at 10 A.M.—Sir Frederic L. Nathan: Industrial Efficiency and the Elimination of Waste (Presidential Address).—At 11.30 A.M.—Exhibition of Chemical Plant (at Central Hall, Westminster).—At 2.30.—(At Mansion House).—Presentation of the Society's Messel Medal to the Earl of Balfour, and Delivery of the Messel Memorial Lecture by Lord Balfour.

Tuesday, July 20.—Society of Chemical Industry (Annual Meeting) (at Hotel Great Central), at 10 A.M.—W. J. U. Woolcock: Presidential Address.—Joint Meeting of the British Chemical Plant Manufacturers' Association, the Institute of Metals, the Institution of Chemical Engineers, and the Chemical Engineering Group for a Symposium on 'Corrosion' (at Hotel Great Central), at 10.30 A.M.—Ulick R. Evans: Fundamental Principles of Corrosion.—Dr. W. H. Hatfield: Chemically Resistant Steels for Chemical Engineering.—P. Parrish: Corrosion and Erosion.—T. G. Elliot and G. B. Willey: Chemically Resistant Steels, with special reference to Very High and Very Low Temperatures.—Joint Meeting of the Bio-Chemical Society with the London Section of the Society of Chemical Industry (at Hotel Great Central), at 11 A.M.—The Scientific and Industrial Problems presented by the Hormones—the Natural Drugs of the Body:—Dr. H. H. Dale: The Experimental Study and Use of Hormones.—Dr. H. W. Dudley: The Chemistry of the Pituitary Gland and of Insulin.—F. H. Carr: The Commercial Production of Hormones.—Dr. H. A. D. Jowett: The History of Adrenalin.—Prof. G. Barger: Recent Progress in the Chemistry of Thyroxine.—Dr. J. W. Trevan: Biological Assay of Hormones.—British Chemical Plant Manufacturers' Association (Annual Meeting) (at 166 Piccadilly), at 2.30.—British Association of Chemists (at Hotel Great Central), at 3.—Dr. Stephen Miall and others: Discussion on Chemistry House.

Wednesday, July 21.—Society of Chemical Industry (Annual Meeting) (at Hotel Great Central), at 10.30 A.M.—Addresses by Sir Josiah Stamp and Sir Max Muspratt, Bart.

Thursday, July 22.—Society of Chemical Industry (Annual Meeting) (at Hotel Great Central), at 10.30 A.M.—Joint Meeting arranged by the Chemical Engineering Group with the Institution of Petroleum Technologists, and the Institution of Chemical Engineers on Power Alcohol.—Dr. W. R. Ormandy: Sugar from Wood.—D. Ross and Dr. W. R. Ormandy: Experiences with Alcohol Motor Fuels.—Joint Meeting of the Institution of the Rubber Industry and the Oil and Colour Chemists' Association (at Hotel Great Central), at 10.30 A.M.—Discussion on The Influence of Particle Size in the Paint and Rubber Industries:—Dr. D. F. Twiss: The Importance of Particle Properties in the Rubber Industry.—G. A. Klein: The Importance of Particle Properties in the Paint Industry.—Dr. S. S. Pickles: Carbon Black.—H. Green: The Necessity for a Direct Measurement of Particle Size.—B. D. Porritt and G. Gallie: An Apparatus for the Estimation of Grit in Pigments.—E. A. Murphy: The Detection of Grit in Rubber Compounding Ingredients.—A. de Waele: The Different Types of Dispersion and some Factors Determining Same.—Dr. P. Schidrowitz: Note on the Influence of Particle Shape.—N. Heaton: The Influence and Elimination of Coarse Particles.

Friday, July 23.—Institution of Chemical Engineers and the Oil and Colour Chemists' Association (at Hotel Great Central), at 10.30 A.M.—L. J. Simon and Prof. J. W. Hinchley: Discussion on Fat Extraction by Solvents.—Fuel Section (at Hotel Great Central), at 10.30 A.M.—Dr. E. W. Smith: Summary of the Symposia at Leeds and Sheffield on Solid Smokeless Fuel.

JULY 22 TO 28.

INTERNATIONAL CONGRESS ON ALCOHOLISM (at Dorpat).

JULY 26 TO 31.

FRENCH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (at Lyons).

AUGUST 3 TO 6.

INTERNATIONAL PHYSIOLOGICAL CONGRESS (at Stockholm).

AUGUST 16 TO 23.

INTERNATIONAL BOTANICAL CONGRESS (at Cornell University).

AUGUST 23 TO 28.

The Presidents of Sections and the Titles of their Addresses are as follow: *A* (*Astronomy, Mathematics and Physics*), Prof. K. Grant, Atomic Transformation; *B* (*Chemistry*), Prof. J. Kenner, Some Aspects of the Problem of Molecular Structure; *B* 2 (*Pharmacy*), A. T. S. Sissons, The Indebtedness of Pharmacy to Organic Chemistry; *C* (*Geology and Mineralogy*), Sir Douglas Mawson, The Igneous Rocks of South Australia—a brief Survey of Present Knowledge relating thereto; *D* (*Zoology*), Prof. L. Harrison, The Composition and Origins of the Australian Fauna, with special reference to the Wegener Hypothesis; *E* (*Geography and History*), Prof. E. Scott, The Discoveries of the Western Australian Coast, with especial reference to Dampier and D'Entrecasteaux; *F* (*Ethnology and Anthropology*), Prof. F. Wood Jones, The Claims of the Australian Aboriginal; *G* (*Social and Statistical Science*), Major L. F. Giblin, Federation and Finance—an Examination of the Financial Relations of States to a Federal Commonwealth; *H* (*Engineering and Architecture*), Sir John Sulman, Town Planning; *I* (*Sanitary Science and Hygiene*), F. S. Hone; *J* (*Mental Science and Education*), P. Board, Social and Economic Values in Education; *K* (*Agriculture and Forestry*), C. E. Lane Poole, Forestry and Land Settlement; *L* (*Veterinary Science*), Prof. J. D. Stewart, The Relationship of Veterinary Science to the Prosperity of the State; *M* (*Botany*), Prof. A. J. Ewart, Past and Future Development of Botanical Science; *N* (*Physiology and Experimental Biology*), Prof. W. A. Osborne, The Study of the Reflex.

AUGUST 26.

MEDICAL WOMEN'S INTERNATIONAL ASSOCIATION (at Prague): Discussions on Tuberculosis and Pregnancy; Women Police-surgeons.

SATURDAY, JULY 24, 1926.

CONTENTS.

Truth and Tradition.

A CURIOUS change is apparent in contemporary thought. The scientific revolution, with its subversive principle of relativity and its paradoxical quantum theory, invaded the calm and secluded groves of philosophy and caused a strange disturbance. The positivity of science, at least in the form which it had assumed in the nineteenth century, seeme to disappear; accepted principles and methods suddenly became suspect; old controversies lost their meaning; new worlds were being discovered. The reception of the new mathematical relativity by philosophers was at first decidedly hostile. An attitude of incredulity was followed by amazement and dismay. When the results of the eclipse observations of May 1919 were made known, and the principle of relativity, which had been formulated fourteen years before by Einstein, was found to be actually verified and confirmed, the interest was no longer confined to academic circles; popular expositions in journals and scientific manuals flooded the book market and every one was eager to be informed. A few mathematicians and many philosophers thought the whole excitement would prove to be a nine days' wonder and hoped, somewhat impatiently, that all would be explained away and that physics would again free itself from metaphysics. The principle of relativity has not been explained away; on the contrary, in an almost incredibly rapid time, it has established itself as orthodoxy. A revolution in ideas which a few centuries ago would have occupied generations now seems to take place between night and morning and while we sleep. At the beginning of the sixteenth century it was discovered by intrepid navigators that our earth is a sphere. It was not until past the middle of that century that a daring thinker suggested that the earth moves, and it was not until a century later than that, and after bitter persecution, that the revolution of ideas which it implied was accomplished.

The extraordinary thing in the present world of ideas is not the scientific revolution, but the fact that it is accepted and that no one expects it to be upset. This does not mean that the spirit of scientific inquiry has ceased its quest and is resting satisfied with its discovery. It does mean that whatever new revolutions are in the future, there is no return to the old ideas. It is the recognition of this fact which is eloquently and forcibly expressed in the two lectures before us—The Fison Memorial Lecture at Guy's Hospital delivered by Dean Inge on March 25,[1] and

[1] Science and Ultimate Truth: Fison Memorial Lecture, 1926, delivered at Guy's Hospital Medical School, March 25, 1926. By the Very Rev. W. R. Inge. Pp. 32. (London: Longmans, Green and Co., Ltd., 1926.) Paper, 1s. net; cloth, 2s. net.

the Herbert Spencer Lecture given at Oxford by Prof. Sorley on May 19.[2]

Dr. Inge points out that there are only three periods of history when knowledge has advanced by leaps and bounds—the time of the ancient Greeks, the Renaissance, and our own age—and of these the greatest accession of positive knowledge has come in our own time. He passes the brilliant pageant in review, and very impressive it is. Yet the philosopher's interest is in the conception of value, and he asks himself, what is the relation of values as they enter as factors into ethical, religious, and æsthetic experience to scientific truth, and especially to the reality which is the ultimate goal of scientific research? The profounder consciousness of contemporary science is not content to detach or dismiss these universal aspects of human experience, the ideals of beauty, truth, and goodness, as epiphenomenal existences, imparting an apparitional glow to cold mechanical order and to which our epiphenomenal minds respond with an emotional thrill. If the real nature of things is to be found in the atom of the physicists, then, as Dr. Inge points out to us, a microbe is nearer to reality than a man. We are, however, still far from the complete philosophy which would show how the different valuations which physics, history, and religion apply to experience supplement each other. This ideal consummation is yet to be attained. The formulation of such an ideal, however, shows that we are on a higher plane of thought. The reproach which has been and still is levelled at religion, that it is ever retreating from one position to another before the victorious advance of science, and that it is now preparing to die in its last ditch, is not undeserved, nor is it entirely untrue. It is the materialism of religion which has constituted its weakness. It is the "garish promises and terrifying threats" which have failed.

Prof. Sorley also is impressed with the consciousness of its own strength which is the outcome of the triumph of the new ideas in physics and biology. The same kind of confidence which Bacon and the leaders of the scientific renaissance expressed when they represented the modern inquirer, not as the patient interpreter of the old learning, but rising on the shoulders of the past, belonging not to the infancy but to the adult stage of our race. He sees to-day a revival of the same spirit which led the young Descartes to choose a military career, not influenced by desire for glory and for worldly success, or by chivalry, but by the opportunity it offered of gaining first-hand knowledge of man and Nature. All the great periods in which there has been a notable advance in science and a revolution in ideas have witnessed a break with tradition, an emancipation from authority. We are going through such a period to-day, and no more profitable subject of self-reflection can be suggested than to take stock of our traditions, their significance, their value, and the nature of the authority they impose. Is tradition a dead hand throttling the living effort? Prof. Sorley shows us the sense in which it is a vital force necessary for the carrying on of original work. "Unless the solitary thinker emerge from his solitude and sow his seed in good soil, his ideas will not fructify." "It is seldom that a second chance comes to the innovator, as it did to Mendel when his work was rediscovered and became the inspiration of a school of biologists."

The two lectures suggest important reflections on the relation of human science to human nature and individual experience. A strange phenomenon is the apparition of man! When we view him as a form of material organisation, the outcome of a biological evolution, and then compare his activity with that of other forms in the hierarchical series, there is presented a phenomenon paradoxical and unique. The unique thing in the human attainment is the power which has come to man alone (it may be by virtue of the erect position, the visual convergence, and the co-ordination of the sense of hearing with the muscles of articulation) of superposing an artificial life on his natural life. There is nothing resembling it or approaching it in the other forms of living activity. Man by reason of his emancipation from environmental conditions has undergone and is undergoing a cultural as well as a natural evolution. The conditions of this cultural evolution are very strange—opposed to, rather than in line with, the conditions of biological evolution. The mind of the ape is moulded on the environment and responds to it as it were automatically. The mind of the man is educable. The culture which a man acquires by education does not modify his nature: it is super-added to it. Man's wisdom is not the wisdom of the bee or the ant. It is artificial. We may grow daily in grace and wisdom, transforming our natural cravings into social virtues, but we do not change the natural man. We cannot transmit our culture as a heritage to the succeeding generation. If we have the gift of expression and leave behind the works which follow us, all we leave is records which set a task for those who will enter into communion with us. Every individual must tread again painfully the path we have had to tread. The flattering notion that an Oliver Twist, born in a workhouse and brought up among thieves, can retain the gentle nature which cultured parents have bestowed on him is a romantic fiction.

It is this which constitutes the real problem of the genesis, the nature, and the authority of tradition. The new generations must start their education not where

[2] Tradition: the Herbert Spencer Lecture delivered at Oxford, May 19, 1926. By Prof. W. R. Sorley. Pp. 24. (Oxford: Clarendon Press; London: Oxford University Press, 1926.) 2s. net.

the old left off, but where the old started. Our generations overlap. It might have been otherwise. Evolution might have produced forms of activity which can retain and preserve individual attainments across a complete breach of continuity. This is the normal case in the insects, but the reverse is the rule in the vertebrates, and in the human form we meet with the formation and growth of an ideal environment, cultural and adventitious. The musician cannot bequeath his acquired skill, the painter cannot impart his acquired technique, the student his erudition. Each individual starts *de novo*, and yet he can only develop under the guidance and influence of the overlapping generation. Hence there grows up around him a tradition and an authority which appear external and seem to restrain him, but which in truth he is himself creating in the very activity of the life which bursts his bondage.

H. WILDON CARR.

Ice-Domes and the Atmosphere.

The Glacial Anticyclones: the Poles of the Atmospheric Circulation. By William Herbert Hobbs. (University of Michigan Studies, Scientific Series, Vol. 4.) Pp. xxiv+198+3 plates. (New York: The Macmillan Co., 1926.) 2.75 dollars.

IN his study of the great ice masses which form the continental glaciers of Greenland and the Antarctic, Prof. Hobbs was impressed with the dome-like shape of their ice-covered surfaces. He also noticed that the predominating wind direction along their coasts had a marked outward component as though the air were sliding off the domes. It was not difficult to find a reason why air should slide off the domes in this way, for meteorologists had long been familiar with the flow of cold air down hill-sides and valleys which occurs when the surface layers of air become abnormally cold owing to intense outward radiation. Sir Napier Shaw has given the name katabatic wind to the winds formed in this way.

Starting, then, with the idea that the air is flowing off the domes outwards in all directions, Prof. Hobbs naturally concludes that it must be replaced by air which is 'pulled down' over the central parts of the dome. But this is the sort of circulation which is described in the old text-books of meteorology as anticyclonic, so Prof. Hobbs assumes that there must be an anticyclone over every dome-shaped ice-covered land. He gives the name glacial anticyclone to such anticyclones; but he categorically states "the domed ice-surface, not the snow-covered land, is the direct cause of the anticyclone" (p. 126).

The outward flow of air, however, is not steady, but takes place in what Prof. Hobbs calls "strophs." Each stroph commences with a calm, then the air starts to move outwards, slowly at first, but acquiring velocity "to accord with the law of acceleration of gravity"; when the velocity has reached full blizzard proportions the motion is suddenly arrested because of adiabatic heating, and the stroph is at an end. Thus the whole regime of the air circulations over the Antarctic Continent and Greenland with their calms, blizzards, föhns and high winds is brought under the dominion of the glacial anticyclones.

The difficulty with all such theories is that the author never knows when to stop, so Prof. Hobbs extends his theory still further. As is well known, the Bjerknes theory of cyclones and the polar front is based on the interaction between polar air and equatorial air. But Prof. Hobbs says that the air in the north polar regions is not suited for such a purpose; in fact, Bjerknes' polar air "is quite different from that encountered by explorers within the north polar region of frozen sea"; what Bjerknes' cyclones want is a dose of air from a glacial anticyclone, so Prof. Hobbs concludes that "the cold air which rejuvenates the dying cyclones on their approach to the coast of Europe from the west, instead of having polar origin, issues from the Greenland Continent during a stroph of the anticyclone" (p. 155). Prof. Hobbs also casts longing eyes on Bjerknes' families of cyclones, but it is not clear whether he claims them entirely as the product of the anticyclone; he does say, however, "when a new stroph is inaugurated a new family of cyclones is generated" (p. 153).

Not content with bringing the cyclones of the northern and southern hemispheres under the dominion of the strophs of his glacial anticyclones, Prof. Hobbs goes still further and claims that the terrestrial climatic zones owe their existence to the glacial anticyclones, and that if there were no iced domes in Greenland and the Antarctic, the world would enjoy the uniform climate which certain geologists consider existed in previous ages. Finally, it is claimed that "these northern and southern glacial anticyclones fixed in position, function as the loci of drainage from the upper wind currents and are therefore the reversing position within the general cycle of air movement—they and not the geographic poles are the wind poles of our planet" (p. 155).

Thus, by a series of plausible steps, Prof. Hobbs has brought practically the whole of the meteorological conditions of the globe and the general circulation of the atmosphere under the dominion of two relatively small ice-domes. We have not the space to criticise this elaborate theory in detail, so a few remarks must suffice. It is now generally agreed that true anticyclones exist over the Antarctic and Greenland, but

these are due to the effect of the snow surface on radiation, and would be there whether the surface were domed or not. In the clear calm air of these anticyclones katabatic winds are often highly developed, and as their direction is practically constant, being always down slope, they produce well marked sastrugi, which can frequently be seen cutting across the sastrugi caused by the blizzards. Katabatic winds, however, need very special meteorological conditions for their existence, the chief of which is that radiation from the surface layers must exceed the radiation received. This is not the case when the sun is high or when the sky is cloudy, as it generally is before and during blizzards. It is possible that the high winds in Adelie Land described by Mawson may be katabatic winds, but until the meteorological data of this expedition are published it is impossible to be certain. We can at least say that the blizzards of the Ross Sea area are not katabatic winds.

That some air from Greenland is drawn into cyclones which pass near to the Greenland coast is clear from the familiar föhn effect which is definitely associated with passing cyclones, but that the cyclonic regime over the North Atlantic would be materially modified if Greenland were reduced to sea-level we cannot accept. The old idea of ascending currents at the equator and descending currents at the poles, in the crude way in which it was formerly stated, has now completely gone. Air cannot be 'pulled down' anywhere; the thermal structure of the atmosphere entirely prevents such motion, and this is as true in Greenland and the Antarctic as it is anywhere else. G. C. SIMPSON.

Infinite Series.

(1) *The Theory of Functions of a Real Variable and the Theory of Fourier's Series.* By Prof. E. W. Hobson. Second edition, revised throughout and enlarged. Vol. 2. Pp. x+780. (Cambridge: At the University Press, 1926.) 50s. net.

(2) *An Introduction to the Theory of Infinite Series.* By Dr. T. J. I'a. Bromwich. Second edition, revised with the assistance of Dr. T. M. MacRobert. Pp. xv+535. (London: Macmillan and Co., Ltd., 1926.) 30s. net.

(1) THE second volume of Prof. Hobson's book completes a great contribution to the literature of mathematics. The second edition is double the size of the first, and is really a new book. Less than half of the present volume is devoted to Fourier series. The rest of it contains an exhaustive account of sequences and series in general.

Of the first part of the book, Chap. vii. is worthy of special remark. In it Prof. Hobson expounds a theorem of his own which states properties common to a very wide class of representations of functions—including Fourier series as a particular case. (We regret that in this chapter and elsewhere the author has continued to use the word *summable* as meaning integrable in the sense of Lebesgue and—a still more trifling criticism—that he has not adopted the arrow notation for passage to a limit.)

It may be held that among all its branches pure mathematics appears at its best in the theory of Fourier series. There is a peculiar sharpness which has been attained in many propositions (and remains to be attained in others), and there is a peculiar cleanness in the arguments which prove these propositions. To take an example at random, let the reader refer to the ten pages of Prof. Hobson's book in which he expounds the theory of Fourier transforms developed in the last three years by Titchmarsh.

This may explain the feeling one has that if there is any part of the book better than another, it is the part dealing with Fourier series. There is a unity in this chapter (scarcely possible in the earlier, more encyclopædic part of the book) which can only have been attained by great pains in fitting the work of many writers into the author's development of the subject. One source of this unification has already been mentioned in Prof. Hobson's convergence theorem.

One wishes that the author could have woven into his general scheme some of the work published since the chapter was written, which could only be referred to, such as the solution by Hardy and Littlewood of the Cesàro summability problem and the beautiful theorems of M. Riesz on the allied series. But, after all, an account of a rapidly growing subject can only be complete—as Prof. Hobson's is—at the time of writing.

The modern theory of trigonometrical series is largely due to Englishmen—one need only mention Prof. Hobson himself, Young, Hardy, Littlewood, and lately Titchmarsh. It is particularly fitting that one of them has written this book.

(2) We welcome very heartily the reappearance of Dr. Bromwich's book, the first edition of which has been out-of-print for many years, to the great loss of the post-War generation of students. Much excellent new matter has been introduced into the second edition. The most substantial additions deal with the solutions of linear differential equations of the second order, elliptic functions, asymptotic expansions, and trigonometrical series.

To make room, the section in the first edition on summability has been omitted. We cannot help feeling that in a book on infinite series *something* should be included about summability, whatever else may have

to go. It would be ungracious to urge that a discussion of Cesàro's method is more germane to the theory of infinite series than an account of Napier's invention of logarithms or of constructions for trisecting an angle, for much that is valuable and delightful in the way of miscellaneous matter has been included. It would indeed have been impossible to give an extended treatment of summability—for that one must go to Prof. Hobson's book—but we wish that the *idea* had been explained. In twenty pages one could prove theorems which show the importance of conventional methods of summation—say, in dealing with Fourier series—and we think that such a sketch would have enhanced the value of the book.

In making this comment on the choice of matter, we had in mind the advanced student: concern for the beginner now suggests a remark. We fear that the early use of the notation $a_n \dashrightarrow b_n + l$ for $a_n - b_n \dashrightarrow l$ may leave him with free and easy notions of what a limit is. Most of the advantages of the new notation seem to be covered by the symbol $\sim$, which is less dangerous.

Prominence is given to those limit-problems which present themselves naturally and at every turn in analysis. Not only to the mathematician is the book indispensable; it is also the best possible guide to any one who encounters mathematical analysis in his work. The second edition will increase the very high reputation gained by the first. J. C. B.

The Chemistry of Drugs and Perfumes.

(1) *A Text-Book of Pharmaceutical Chemistry.* By Arthur Owen Bentley and John Edmund Driver. Pp. xi + 456. (London: Oxford University Press, 1925.) 18*s*. net.

(2) *The Chemistry of Drugs.* By Norman Evers. Pp. 247. (London: Ernest Benn, Ltd., 1926.) 32*s*. 6*d*. net.

(3) *Perfumes, Cosmetics and Soaps, with Especial Reference to Synthetics.* By William A. Poucher. Vol. 1: Being a Dictionary of Raw Materials. Second edition. Pp. ix + 304 + 21 plates. 16*s*. net. Vol. 2: Being a Treatise on Practical Perfumery. Second edition. Pp. xvi + 406 + 42 plates. 21*s*. net. (London: Chapman and Hall, Ltd., 1926.)

THE issue of elementary text-books for particular groups of chemical students is usually a proceeding to be deprecated, but there is something to be said for it in the case of students intending to qualify as pharmacists, for they need special information regarding chemicals used in medicine, and they must know something about such substances as alkaloids and glucosides and the methods by which they are estimated; subjects which are outside the scope of ordinary text-books. Messrs. Bentley and Driver's book (1) meets these and other needs of pharmaceutical students, and the authors wisely point out that it must be regarded as supplementary to a general course in elementary chemistry. For use in this way the book can be cordially recommended. The few errors noted are of minor importance, such as the representation of prulaurasin as a diglucoside on p. 4 and as a monoglucoside on p. 383. It is curious that there is no reference to the digitalis glucosides or to the alkaloid emetine, both drugs of great importance in modern medicine with which pharmacists ought to be familiar.

Any one who has used such a book as Fränkel's "Arzneimittel Synthese," or skimmed through one of those formidable 'Dispensatories' published in the United States, must be appalled at the number and variety of substances which exhibit physiological action and are potential drugs. Mr. Evers's book (2) serves the purpose of picking out the valuable drugs from this mass of material, and is at least usefully suggestive as regards the lines on which progress in chemotherapy is being made. The chapters on such familiar subjects as hypnotics, antipyretics, anæsthetics, and antiseptics are well done, being neither overloaded with unimportant materials nor neglectful of essential points.

It is interesting to find that out of 218 pages of text, synthetic drugs occupy only 66 pages, the rest being required for the discussion of natural drugs containing alkaloids, glucosides, etc. It is sometimes forgotten, especially by chemists, that medicine still depends so largely as this on drugs of natural origin. The work of compilation has been carefully done, and the only points noticed as requiring attention are of minor importance, such as the implication that chenopodium oil is produced in the West Indies and Central America, whereas it is only distilled in the United States. The statement that "though numerous derivatives of such drugs as atropine, cocaine, quinine, adrenalin, and emetine have been prepared and tested, not one of the derivatives has surpassed the natural drug in maximum effect" is true only in a Chestertonian sense, for the author himself mentions quinine derivatives which surpass the parent alkaloid in activity as anæsthetics and antiseptics. Appendix I., in which this statement occurs, is a too brief summary of current information on the relationship of chemical constitution to physiological action, a subject of great importance, which merits much more elaborate treatment than it receives.

It is typical of the difficulty of keeping books like this up-to-date that Kendall's views on the properties and constitution of thyroxine, which are given in considerable detail, have been superseded by the results of the recent admirable work of Harington. Interest in

the chemistry of drugs is steadily increasing, and Mr. Evers has performed a useful service in providing students with this survey of present knowledge on this subject.

(3) A mere chemist is interested to learn from Mr. Poucher's two volumes that so many chemicals have properties which enable them to be applied to the preparation of toilet requisites, but the reader must be more than a chemist to appreciate at its full value such information as the following. "Alloxan, or mesoxalylurea, is used in the preparation of 'blush' creams on account of the fact that it will impart to the skin a delicate pink tint, if used in a very dilute form." "If too high a percentage of alloxan is employed a purple colour is produced, which may be removed by treatment with dilute nitric acid." Clearly, the modern woman may yet be driven into taking a course in chemistry in the interests of her complexion. The author is naturally not always at this high level, and the bulk of the two volumes is occupied with more prosaic information regarding the sources, production, and uses of the immense variety of materials now used in the manufacture of perfumes, cosmetics, and soap, and the recipes beloved of the practical man are abundant. The book no doubt thoroughly deserves the popularity it has obviously secured from those for whose instruction it was written. T. A. H.

Our Bookshelf.

Handbuch der Zoologie: eine Naturgeschichte der Stämme des Tierreiches. Gegründet von Prof. Dr. Willy Kükenthal. Herausgegeben von Dr. Thilo Krumbach. (1) Dritter Band: *Tardigrada, Pentastomida, Myzostomida, Arthropoda: Allgemeines, Crustacea, Arachnoidea.* Erste Lieferung. Pp. 128. 12 gold marks. Zweite Lieferung. Pp. 129-272. 15 gold marks. (2) Fünfter Band: *Solenogastres, Mollusca, Echinodermata.* Erste Lieferung. Pp. 96. 10 gold marks. Zweite Lieferung. Pp. 97-176. 8·40 gold marks. (Berlin und Leipzig: Walter de Gruyter und Co., 1925–1926.)

(1) THE section on the Tardigrada, which was finished by the late Prof. F. Richters in 1914, has been revised by the editor. It is an altogether admirable account in 61 pages of the structure, biology (including the remarkable powers of recovery after drying), development, distribution, affinities and systematics of the order, and is illustrated by 68 excellent figures, many of which are original. The editor has appended a list of about 130 memoirs on tardigrades. The Pentastomida are described in about 60 pages by Prof. R. Heymons, and this account also is praiseworthy for the adequate and well-balanced treatment of the subject. The author would place the Pentastomida between the Annelida and the Arthropoda, and near the other short-footed arthropod-like forms such as Tardigrada and Onychophora. In the section on the Myzostomida (about 80 pp.), by Prof. von Stummer-Traunfels, we find again adequate consideration of structure, biology and life-history, together with excellent figures, for the most part from recent memoirs. The effects of the presence of Myzostoma upon the respective crinoid hosts are clearly set forth. We can thoroughly recommend these three sections to the attention of teachers of advanced zoology. The remainder of the second part is occupied by a general introduction to the morphology and phylogeny of the Arthropoda, written by Dr. Anton Handlirsch.

(2) Prof. Johannes Thiele, the author of these two parts, prefers to regard the Solenogastres as separate from the Mollusca. In the account of the order (14 pp.) more might have been given on the development, and figures to illustrate the more important stages should have been provided. The part on the Mollusca contains a brief general introduction, and accounts of the classes Loricata (Chiton, etc.), Gastropoda, Scaphopoda and Bivalvia, this last to be concluded in the third part. The best of these accounts is that of the Loricata, but here again the author does not provide figures of the developmental stages or of the excretory organs.

While we admit that it is difficult to give adequate consideration to the several systems of organs of the Prosobranchia, we cannot help feeling some disappointment in looking over the account of the sense organs and nervous system (which together receive the same space as the radula), and surely it would have been more helpful to have figures of egg capsules of known origin rather than those of unknown parentage which are given on p. 67. The classification of the Prosobranchia is well done, but some of the subdivisions, *e.g.* Heteropoda, deserve fuller treatment on account of their special interest. Certain aspects of molluscan morphology, *e.g.* torsion, have not received adequate consideration. The account of the Scaphopoda occupies less than 5 pp., and the only illustrations represent the shell, the animal removed from the shell, and three of the radular teeth; there are no figures of the internal anatomy or of the developmental stages.

The systematic part of this work is satisfactory, but the descriptions of structure and development leave much to be desired. As compared with the third volume, the present volume is far less adequate in both text and illustrations.

Volatile Solvents and Thinners used in the Paint and Varnish Industries. By Noël Heaton. (Oil and Colour Chemistry Monographs.) Pp. 158. (London: Ernest Benn, Ltd., 1925.) 15s. net.

IN less than 140 pages of text the author has attempted the task of compiling "for reference and comparison detailed information as to the nature, preparation and properties of every solvent of industrial importance in the paint and allied industries." His sixty-odd substances are broadly classified under the heading of petroleum and coal-tar hydrocarbons, hydrocarbon chlorides, terpenes, alcohols, ketones, ethers, esters, and in addition, carbon disulphide. His claim that his list of individual solvents includes every one of the type indicated is scarcely correct, especially in the United States, where the lacquer trade has made enormous strides in recent years. There is a final short chapter on the general significance of the tests for solvents, with some theoretical considerations involved in their use.

A large proportion of the material in this book can be found in many theoretical organic chemistry books, and in view of the comparatively high price of the volume it might be advisable to have restricted such matter and to have dealt more with the technical application of the solvents. Some typographical errors and a fair number of obscure or slightly inaccurate statements occur, but in spite of these and the author's disclaimer to literary style in dealing with technical data, the book is exceptionally well written. It collects together a large amount of useful information on a special type of organic substances, and it should be of great use not only to the technical man but also to the organic chemist generally. J. REILLY.

Castles. By Sir Charles Oman. Pp. xii + 232 + 100 plates. (London: Great Western Railway, Paddington, 1926.) 5*s.* net.

To the two delightful volumes, "Cathedrals" and "Abbeys," the Great Western Railway has now added a third dealing with the castles on or accessible from its system. Eighty castles in the south and south-west of England and in Wales are here described in full and illustrated by many photographic plates of great beauty and a number of equally pleasing sketches in the text. All the castles with the exception of six have been carefully inspected by the author, while his son was responsible for about half the illustrations. In addition to the description of each building and the notes on its history, Sir Charles Oman has provided an introduction in which he gives the history of the castle, royal and baronial, in England, and sketches its development as well as the development in methods of attack which took place *pari passu*—a subject on which so distinguished an authority on military history is peculiarly competent to speak. Sir Charles discusses at some length what constitutes a castle, and finally defines it as a military structure used for residential purposes which is a unit as itself. It is interesting to note that the author attributes the fact that castle building virtually ceased in the fourteenth century, not so much to the development of artillery, though that was no doubt a contributory cause, as to the realisation by that time that war in the open had come to be the only form of decisive action, and it was consequently more effective to spend money on the maintenance of men-at-arms rather than in buildings.

The Chemical Analysis of Foods: a Practical Treatise on the Examination of Foodstuffs and the Detection of Adulterants. By Dr. H. E. Cox. Pp. vii + 323. (London: J. and A. Churchill, 1925.) 18*s.* net.

THE aim of the author has been to write a text book of food analysis for the general requirements of chemists who have no special experience in the analysis of foods. On the whole he has produced a compact and readable volume which contains a large amount of useful information. In eleven chapters the subjects dealt with include carbohydrates, baking-powder, fruits, tea, coffee, cocoa, mustard, pepper, wines and other alcoholic liquors, flesh foods, milk and related products, and various oils. In an appendix the Public Health (Preservatives, etc.) Regulations of 1925 are given.

Methods are often too briefly described to be of real value to the inexperienced, and the details given are not always strictly accurate. In some cases definite alterations in standard existing procedure is indicated without comment or reference to original sources. The expert analyst is certain to be disappointed in many sections of the book, for in several instances where information is required, even on common controversial problems, little help is given. There is possibly some justification for this, as the author indicates that he is not writing for the specialist, and has endeavoured only to present the elements of the subject. The book is therefore more useful in initial training than as an aid in discussing special isolated points. In a second edition with a fair amount of revision and correction a very useful text-book should result.

Economic Geography of South America. By Prof. R. H. Whitbeck. Pp. vii + 430. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1926.) 17*s.* 6*d.* net.

THERE has long been need for a text-book on South American economic geography, since much that has been written on this subject is not free from bias and is far from trustworthy. In this volume, Prof. Whitbeck, who has the necessary qualification of personal experience of South America and a wide outlook, has largely supplied the want. The physical background is merely sketched and there is little explanation of climatic processes. These are the weak sides of the book. But the economic problems are ably handled, and the human element, which is of great significance, is kept well in the foreground. States are selected as geographical entities, but within the larger States natural regions are recognised. National boundaries, traditions, and even prejudice, play too important a part in the economic life of any State to be neglected, as must happen if natural or geographical regions are chosen as the larger units for treatment. The Falkland Islands may be of small importance, but they merit more than one casual reference, at least if the book is to be used in Great Britain. There are admirable illustrations and sketch-maps and copious bibliographies, while the text shows a pleasing absence of New World phraseology.

The Human Body. By Dr. Marie Carmichael Stopes. Pp. v + 224 + 7 plates. (London: The Gill Publishing Co., Ltd., 1926.) 6*s.* 6*d.* net.

FEW will venture to deny that some elementary knowledge of the structure and working of the human body should be included in the education of every child. To further that object, Dr. Marie Stopes offers this book to adolescents and to all who missed this knowledge when they were young. In general, it is eminently suitable for the purpose; it is simple in expression, clear and accurate in detail, and easily readable by any youth of average intelligence. There are, however, certain features of anatomy and physiology which cannot adequately be explained in print; they are best left to the tact and common sense of the parent or guardian, and their omission from this book would certainly have increased its sphere of use, to those, at least, who are passing from childhood to youth. The only other criticism we have to offer is that technical terms, such as 'omos,' 'lumbus' and 'natis,' are unnecessary even in the diagrams of a book intended for lay readers.

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Secondary Hydrogen Spectrum.

THE further examination of the secondary spectrum of hydrogen has led to a number of interesting discoveries since my last publication (*Roy. Soc. Proc.* A, vol. 111, p. 714, 1926). It appears that the green and red bands have the same electron jump but correspond to different sets of vibrational transitions, those for the green bands being 0→0, 1→1, 2→2, 3→3, and 4→4, and those for the red bands 1→0, 2→1, 3→2, 4→3, 5→3, and 6→5. In addition, there are five other less well developed sets of bands with the same electron jump, two in the infra-red with vibrational transitions 2→0, 3→1, 4→2 and 3→0, 4→1 respectively, and three on the violet side of the green with the respective sets of vibrational transitions 0→1, 1→2, 2→3, 3→4 and 0→2, 1→3 and 0→3. There is an intercombination between the lines of all the above bands and indications of a further combination in the members of the PR branches, which, however, are less well developed than the Q branches. The second differences of the Q branches form a square array with a common vertical difference = 2·4 and a common horizontal difference 2·8 wave number.

The blue bands have a different electron jump from the foregoing. It appears that there are less well developed bands on the violet side of these, which are connected with them and with the red bands by means of a Rydberg formula. Thus if the first element on the violet side of each band is indicated as usual by the letter A, the frequencies of the successive lines AQ (1) are given by the formula

$$\nu = 109678\,3 \times \left\{ \frac{1}{(2-\mu_1)^2} - \frac{1}{(m-\mu_2)^2} \right\}.$$

The value of μ_1 is approximately 0·067 and μ_2 falls steadily from about 0·063 to 0·058 as m increases from 3 to 7. Evidence of the bands can be found for each of the values $m = 3, 4, 5, 6, 7$. When $m = 3$ we get one of Fulcher's red S_3 lines, the one, in fact, nearest the violet end, and when $m = 4$ we get the first line at the violet end of Dieke's blue bands. There is also evidence of the existence of a similar lot of bands connected by a Rydberg formula with the green bands. There can be little doubt, in view of the above equation, that this system constitutes the band analogue of Balmer's series.

O. W. RICHARDSON.
King's College, University of London,
July 11.

Imperfect Crystallisation of Common Camphor.

QUITE recently (NATURE, May 22, p. 721) A. Müller described the imperfect crystallisation of behenolic acid. The crystals of this substance proved to be built up of small crystal elements which have one direction in common and a random orientation perpendicular to this direction. This seems to be the case with many long-chain compounds.

As another example of such an imperfect crystallisation where, however, the imperfection is still greater, I should like to mention common *d*-camphor (Japan camphor). This substance, which, according to Traube, crystallises in the trigonal-trapezohedral class, was studied in the course of an investigation of the space-groups of some optically active crystals. The rotatory dispersion of camphor crystals is practically the same as the rotatory dispersion of the substance in the melted, gaseous and dissolved states (L. Longchambon, Thèse, Paris, 1923; *C.R.*, **182** (1926), 769). It was therefore supposed that the crystals might prove to possess no trigonal screw-axes, and thus owe little or none of their rotatory power to the molecular arrangement within them.

Assuming that the crystals are truly trigonal or hexagonal, their tabular form is in favour of this hypothesis. Indeed, the best developed planes in any crystal (here {0001}) are generally those which are the most closely packed with molecules. The presence of a threefold screw-axis would reduce the molecular density of the basal plane to one-third of the value which would hold in the case of a threefold rotation axis.

The crystals used were found in a bottle in which they had been produced by slow sublimation, apparently over a number of years, at room temperature. They consisted of thin hexagonal plates. The X-ray investigation showed, however, that the external form of the crystals is deceiving.

With the Bragg spectrometer never more than three reflections were observed, corresponding to the planes which occur on the crystals. From them the following spacings were deduced: $d_{0001} = 5{\cdot}80$ Å.U., $d_{10\bar{1}1} = 5{\cdot}42$ Å.U., $d_{10\bar{1}0} = 6{\cdot}06$ Å.U. (indices according to Traube). Actually, d_{0001} must be multiplied by 2 to make these spacings consistent. They give for the axial ratio 1·656 (Traube, 1·685). The hexagonal unit calculated from them contains two chemical molecules (1·95). Strange to say, a reflection from {11$\bar{2}$0} was never observed on the spectrometer. Many rotation- and oscillation-photographs were taken with different settings of the crystals (with regard to the outer form). None of these photographs showed the typical hyperbolæ of spots that would be expected. All of them showed only a relatively small number of spots, more or less distributed in a circle round the centre. Although the spots corresponding to the three planes mentioned above were generally found in positions where they would be expected, still no spot that could be definitely identified with {11$\bar{2}$0} was ever found. On the other hand, there were always spots in positions which bore no definite relations to the setting of the crystal. As a consequence it was practically impossible to deduce trustworthy conclusions from the *positions* of the spots on the plates. Clearly, what are apparently good crystals are in reality no more than conglomerations. Laue photographs seem to confirm this view. Several of them were taken in a direction perpendicular to the basal plane, but a hexagonal or trigonal distribution of spots was never obtained. There were a number of broad spots which appeared to correspond to a more correctly orientated larger part; but mostly the spots were drawn out into lines and located in circles round the centre. It should be noted that no definite indication of a larger constituent could be deduced from the rotation- and oscillation-photographs. The sharp spots must correspond to small crystals having a random orientation.

A small number of spacings were obtained from the oscillation-photographs. Attempts were made to increase this number by taking powder photographs, but a real powder could not be obtained. Rubbing camphor in a mortar effects an orientation of the crystal elements with the basal planes more or less parallel to the surface of the pressed substance. An oscillation photograph of this surface gave a strong reflection corresponding to the spacing of the basal plane. Subliming quickly on a cold surface produced crystals which were too big to be considered as a powder.

The spacings obtained are not sufficient to determine definitely the crystal unit. When a hexagonal or trigonal unit was assumed, it was only possible to account for the spacings by taking a much larger unit than would follow from the spectrometer measurements and assuming a number of accidental halvings, etc. In the course of the investigation there were also indications which seemed to point to the possibility that the crystals are not truly hexagonal but intergrowths of biaxial lamellæ. For example, on several photographs double spots were present, and once a very fine stratification of lines making angles of 60° with each other was observed on a thin layer of camphor which crystallised on the surface of a solution of camphor in aqueous methyl-alcohol. If the crystals are really biaxial, an artificial spiral of lamellæ must be present to account for the uniaxial nature of the composite crystals.

The imperfection of the crystals is probably due to the changes in temperature during the long time which is necessary for their growth. With rising temperature crystal elements resublime, whereas at lower temperatures new crystal elements are deposited. It is possible that the orientations of these latter are variable.

It is hoped that crystals will be grown from a solution later, and that better results will be obtained with them.

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Influence of Temperature on Biological Processes.

THE study of Van 't Hoff's law in biology has led to the following main conclusions:

1. Biological reactions showing a $Q_{10} = 1.1$ are of a photochemical nature.
2. Biological reactions with a negative Q_{10} are based upon surface forces.
3. In the remaining cases the Q_{10} lies between 1·3 and 6·0, but usually this value depends much less on the nature of the reaction involved than on the temperature itself, the Q_{10} of one and the same reaction being higher at low than at high temperatures. Thus in these cases the Q_{10} is not a true constant, and Van 't Hoff's formula does not fully hold. It might be noted here that even in many chemical reactions the Q_{10} is not absolutely constant but that it varies slightly with the temperature. In the overwhelming majority of biological processes, however, this variation is much more considerable.

For that reason some investigators have introduced the Arrhenius formula $\left(\frac{v_2}{v_1} = e^{\frac{\mu}{2}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)}\right)$ into biology. Ch Snyder[1] was the first to do so, and has been followed, in recent years, chiefly by W. J. Crozier.[2] The latter author, however, finds that the coefficient μ of the above-mentioned formula of Arrhenius is not always uniform for one and the same reaction, but that it has in many cases at least two, and according to Cole[3] even three, different values for different ranges of temperature. Thus the Arrhenius formula should not be generally used in biology (see Heilbrunn's criticism[4]).

Many biological observations unfortunately are not sufficiently accurate to serve as the basis for a quantitative law. However, after trying various mathematical formulæ for a large number of cases recorded in the literature, I have found that the following equation usually represents the relation

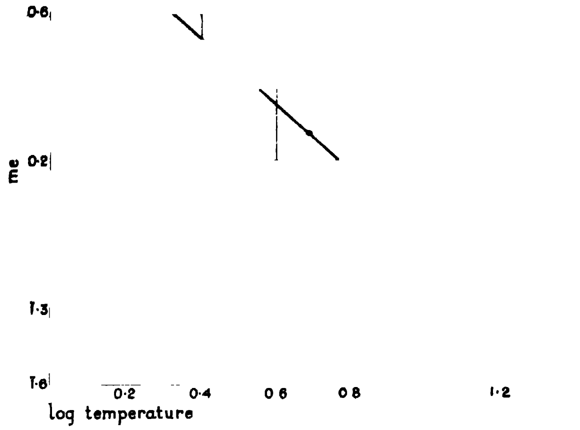

FIG. 1.—Effect of temperature on the locomotion of marine amœbæ (Pantin's experimental data).

between the temperature (x) and the time (y) necessary to accomplish a given reaction:

$$y = \frac{a}{x^b}, \qquad (1)$$

a and b being constants. In logarithmic form the formula becomes:

$$\log y = \log a - b \log x, \qquad (2)$$

which means that the logarithm of time plotted against the logarithm of temperature gives a straight line The following examples, which give good lines, show that the formula is very general.

Reaction.	Species			
Pulsation of the vacuole	Paramæcium	Cole[3]	5460·0	1·87
Amœboid movement	Marine amœbæ	Pantin	7·76	0·90
Growth	*Scirpus Kisoor*	Bose[6]	346 10[12]	9·50
Oxygen consumption	*Tenebrio molitor* chrysalids	Krogh	2819·0	2·10
Vasomotor effect on ischiadicus	Cat	Howell[8]	3802·0	2·02
Regeneration	Tubularia	Moore[9]	5012·0	1·70

Figs. 1 and 2 show the curves obtained in two of the above reactions.

The constant a expresses the time at $+1°$, as it may be calculated in putting $x = 1$. It is evident that the value of a varies according to the unit of time used. The value of b is independent of the actual velocity and of the unit of time employed, because b represents an acceleration.

If $b = 1$, the formula becomes

$$y = \frac{a}{x}, \qquad (3)$$

which is the general equation of a rectangular hyperbola. Some entomologists have put forward the hypothesis that the product of temperature and time in the embryonic development of insects is a constant for one and the same species. This hypothesis may be written mathematically in the form given above (3), and is therefore only a special case of the more general equation (1).

Krogh,[10] Warburg,[11] and others have shown that

[1] Snyder, *Arch. für Anat. und Physiol.*, 1907, p. 113.
[2] Crozier, *Journ. Gen. Physiol.*, **7**, 1924; *Proc. Nat. Acad. Sci.*, **10**, 1924.
[3] Cole, *Journ. Gen. Physiol.*, **7**, 1925.
[4] Heilbrunn, *Science*, **62**, 1925.

Pantin, *Brit. Jour. Exper. Biol.*, **1**, 1924.
Bose, *Trans. Bose Res. Inst. Calcutta*, **1**, 1918.
Cf. Robertson, "Principles of Biochemistry," 1920.
Howell, Budget and Leonard, *Journ. of Physiol.*, **16**, 1894.
Moore, *Roux's Archiv*, **29**, 1910.
Krogh, *Zeitschr. für allg. Physiol.*, **16**, 1914.
Warburg, *Bioch. Zeits.*, **100**, 1919; **103**, 1920. Yabusoe, *ibid.*, **152**, 1924.

some biological reactions are affected by the temperature in such a way that the velocities themselves plotted against temperature (*not* their logarithms) give a straight line instead of the exponential curve of Van 't Hoff. Expressed mathematically, this fact may be written (v = velocity, x = temperature):

$$v = kx, \quad . \quad . \quad . \quad . \quad (4)$$

and if we take time y instead of velocity ($y = 1/v$) and if we put $k = 1/a$, we may write:

$$y = \frac{a}{x},$$

which is the same as the equation (3). Thus the linear relation between time and temperature is true when b in the general formula (1) becomes = 1.

If we construct a curve based on any arbitrary case of the general formula (1) and then calculate the Q_{10} of that curve in the same way as is usually done

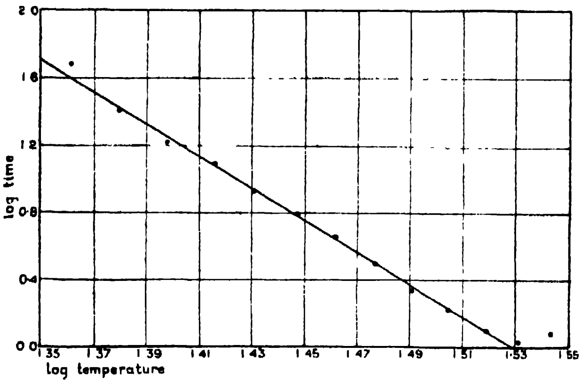

FIG. 2. Effect of temperature on growth of *Scirpus Kisoor* (Bose's experiments).

in biology, we find that the value of Q_{10} decreases with rise of temperature in the same manner as in the majority of actual biographical reactions, provided always that b is greater than 1.

At high temperatures (near and above the optimum) the formula of course does not hold, because of changes occurring in the protoplasmic equilibrium. Sometimes it may also be observed that at very low temperatures (in the neighbourhood of 0° C.) the calculated and actual values do not correspond; this is due to the fact that in the previous calculations the possible difference between the physical zero (0° C.) and the biological zero has been neglected. If the biological zero is below 0° C., the calculated points possess somewhat higher values than the points observed, and vice versa. When the temperature is measured from the biological zero (which may be expected to lie not very far from 0° C.), these divergences at low temperatures disappear.

Variations in the constant b in formula (1) appear to have considerable biological significance. I hope to show in a later note that, for the same reaction in one and the same species, b increases with age; also that it is larger in homothermic than in poikilothermic animals, and in tropical than in temperate plants.

J. BĚLEHRÁDEK.

King's College, London, June 11.

Migrations of Butterflies.

IN NATURE of April 11, 1925, p. 535, I gave an account of certain annual movements of the Painted Lady Butterfly (*Pyrameis cardui*) and ascribed them to a deliberate migratory effort on the part of the insect.

In NATURE, September 5, 1925, p. 365, and again on May 29, 1926, p. 754, Dr. E. P. Felt has suggested that this interpretation of the facts is wrong and that in reality we are dealing only with another form of the more general phenomenon of the involuntary distribution of insects by means of overpowering wind currents along the surface of the earth, or upwards by convection, and then along at high altitudes.

No one will disagree with Dr. Felt as to the frequence of involuntary distribution. On the other hand, the evidence that the seasonal movements of such butterflies as *P. cardui*, *Anosia plexippus* and various species of *Catopsilia*, etc., is an entirely different phenomenon, is too long to give in detail in a short letter. I have prepared a fuller statement of the arguments for and against, which will be published elsewhere.

However, one or two points might be summarised here.

(1) The evidence that enormous unidirectional flights of butterflies takes place at ground level, apparently independent of wind direction, or at least more often against or across the wind than with it, is overwhelming. I have more than five hundred references to flights of more than one hundred species in my bibliography for Lepidoptera alone, and the records are multiplying almost daily. The point in dispute seems to be to what distance such flights extend

(2) In the Pulney Hills in South India, Mr. Evershed has observed for more than ten years a regular stream of butterflies of four families going to the south in November and December almost every year, and a northerly stream of Pieridae in the earlier months of the year about March. He is convinced that these flights are independent of wind direction.

(3) In the Argentine, Hayward (*Entomologist*, 1925, pp. 147 and 162) records numerous butterflies 'migrating' to the north and flying near the ground when the wind was against them and high up when it was favourable, *i.e.* making use of the wind when possible but not in any way dependent on it or driven by it.

(4) Dr. Felt suggests that as the north and north-west movement of *P. cardui* between March and June over N. Africa and Europe is against the prevailing ground winds, it must therefore be due to upper air currents. I have collected information about the upper air currents in Egypt and the Mediterranean basin, and find that it is necessary to go up from two to four kilometres to get from the ground winds (prevailing north) to a permanent steady westerly upper current. At no height is there any wind current that would account for the migration. The most favourable conditions for the northerly drift of unresisting objects would be with a southerly wind. When there is such at the surface in Egypt, it has veered to south-west at a height of one kilometre and to the permanent west current between two and three kilometres. It should also be emphasised that it is not when there is a south wind, but when there is a north or north-west wind, that thousands of Painted Ladies pass steadily to the north or north-west through the Cairo district.

(5) Practically the same conditions apply with the southerly migration of the Monarch Butterfly in the eastern U.S.A. in the autumn. Neither at the surface nor at any height above it are there prevailing winds to account for the movement.

(6) If the great spread of these insects is due to involuntary drift at high altitudes, why do they continue to move, over many miles at least, in a set direction, often against the wind, when they come to the surface again? (or is it before they go up?). The mad, untiring unidirectional flight of butterflies is a thing apart from their normal flight and cannot

be accounted for except by profound physiological disturbances such as are found in birds during migration.

It is difficult not to add, although it is not argument, that if Dr. Felt had once seen a hundred thousand butterflies going headlong against the wind, or coming out of the bare desert like a thin haze, or flying out to sea without taking any other interest in a steamer than that necessary to avoid it, he would realise the complete lack of identity between this and the willy-nilly drift that carries aphids to Spitsbergen or mosquitoes and house-flies to the Rebecca Shoal Lighthouse.

C. B. WILLIAMS.

Ministry of Agriculture,
Cairo, Egypt, June 10.

Series Spectra of the First Long Period.

THE regular and irregular doublet laws have been applied to some lines which appear in the high-potential spark of scandium, titanium, vanadium, and chromium, and those listed in the table appear to be the first members of the *P* doublets of Sc III to Cr VI. For convenience, those of K I and Ca II have been included from Fowler's "Series in Line Spectra."

Element	λ.	I.	ν	$\Delta\nu$.
K I .	7664·94 7699·01	10 *R* 10 *R*	13042·8 12985·1	57·7
Ca II .	3933·7 3968·5	10 *R* 10 *R*	25414·4 25191·6	222·8
Sc III .	2699·9 2734·9	10 9	37038·4 36564·4	474
Ti IV .	2067·6 2103·4	9 8	48363 47542	821
V V .	1680·4 1722·7	5 3	59510 58048	1462
Cr VI .	1446·7 1498·0	4 2	69123 66756	2367

The wave-lengths were measured *in vacuo* on a two-metre grating having 30,000 lines per inch, giving an average dispersion of 4·5 Å U. per mm.

There is no doubt that from scandium onward the intensity of these pairs falls steadily as indicated, but there is no direct comparison intended between these and potassium or calcium. It may be said, however, that calcium and scandium were taken on the same plates in some cases, and the calcium doublet was strongly reversed and apparently very much more intense than that for scandium.

When the intensity ratio of the two lines of each pair is considered, it is found that the shorter line is always the more intense of the two.

The corresponding doublet for Mn VII falls in a region having many strong lines, mostly due to silicon, and so no definite conclusion could be arrived at regarding its existence.

The origin of these pairs seems unexplained, since each of these elements from calcium onward is supposed to have but two electrons in the *N* levels, unless we assume that when these are removed some of the *M* electrons move out to take their places in a manner similar to that discussed by Catalán (*Phil. Trans.*, A, vol. 223, p. 166). Some such assumption seems necessary to explain chemical and magnetic results. It seems possible, also, that there may be some connexion between this and the decreasing intensity of the pairs.

The doublet for Sc III was arrived at independently by Mr. S. Smith, who spent considerable time looking for further series relations for this system, but while several pairs having the same separation are known, no certain results have been found.

R. J. LANG.

University of Alberta,
Edmonton, Canada,
May 25.

Technical and Intellectual Values.

IN the leading article in NATURE of June 12, the Association of Teachers in Technical Institutions is invited to publish the philosophy of that branch of education in which its members are specialists. A series of principles is urgently required, and this the Association has formulated, partly philosophical, partly scientific. Control experiments to check our hypotheses are now in the process of performance through the medium of Lord Emmott's Committee of Inquiry into Technical Education, which was suggested, and the preliminary work undertaken by the A.T.T.I., but which is now under the control of an executive committee representative of industry, local education authorities, learned institutions, and technical teachers, with Mr. J. Wickham Murray as its honorary secretary. The guiding principles which are asked for will soon be in a form suitable for publication, and will then be submitted to the reading public for criticism and suggestion.

The urgent need for their formulation and publication is shown by recent speeches of the president of the Board of Education. In his opinion, secondary education is the preparation for a university education destined to provide the 'governing classes'—to use his words as reported in the press. Such a typically constricted outlook must be widened. The function of a government does not end with the manipulation of Emergency Powers Acts. Industry and commerce must be encouraged and fostered. Whether governmental philosophy be individualist or collectivist, we shall require men with technological training and capable of the application of science to the industrial world. Education must include education for service as well as for government, and this service must be intelligent: not a clumsy translation of good intentions into feeble practice.

A. E. EVANS, President.

Association of Teachers in
Technical Institutions,
29 Gordon Square,
London, W.C.1.

Natural History of the New Hebrides.

IN a few months my brother and I are going to the New Hebrides, in the Pacific Ocean, to explore the interior of the largest island, to collect the fauna, to study animal reproduction in a climate that is almost constant throughout the year, and to undertake other work of a more special nature. Particular interest attaches to a large lake on one of the islands, said to be almost the only lake in Melanesia. We are financed in part by the Trustees of the Percy Sladen Memorial Fund.

If any reader of NATURE who is a specialist in any group of terrestrial or fresh-water animals or their parasites would care to communicate with me, I should be glad to make a particular point of collecting that group and of sending the specimens to him on our return, provided that he will undertake to work out the collection and subject to the approval of the Percy Sladen Trustees.

JOHN R. BAKER.

Department of Zoology and
Comparative Anatomy,
University Museum, Oxford.

The Imperfect Crystallisation of Common Things.[1]

By Sir WILLIAM BRAGG, K.B.E., F.R.S.

MANY things consist of, or contain, agglomerations of small crystals which are plain to the eye or may be made evident by the use of the microscope. Many more are only discovered to be of similar composition when they are examined with the aid of X-rays, as for example, fats, cotton and silk. In some cases the small crystals are in complete disorder. In others there is a partial arrangement; some one direction related similarly to each crystal has a tendency to orient itself more or less in a certain direction related to the body of which the crystals form part. When this happens there must necessarily be a cause for it. The body may have been subjected to strain or mechanical treatment of some sort, as when a metal sheet is hammered or rolled, or when a metal wire is drawn. Or again the body may have been formed under conditions which favour orientation, as when a substance is deposited electrolytically. Yet another case of great interest is that of animal or vegetable structure; the general orientation of the crystallites in cotton, silk, animal scales and spines, teeth and the like, has features which are clearly associated with growth.[2]

It is most probable, in some cases it is already certain, that the presence of the small crystals and their arrangement affects the properties of the body which contains them. We know that the strength of a wire depends on the arrangement of its constituent crystals; the strength of a cotton fibre, or of a bone, is most probably affected in the same way. It is part of Nature's scheme to produce this partial orientation in living things, so that a knowledge of it may be essential to the understanding of the structures which contain it. To this knowledge the X-ray diffraction figures, which are formed on the photographic plate in the customary ways, are able to contribute materially. These figures are of various types. One of them is the original Laue diagram which is obtained when a

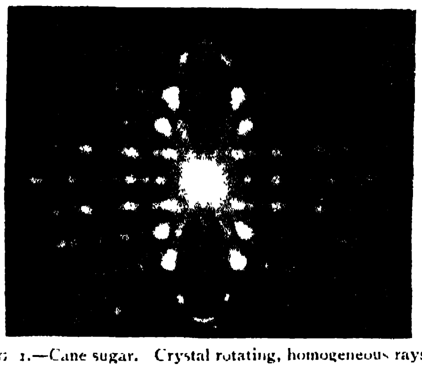

FIG. 1.—Cane sugar. Crystal rotating, homogeneous rays.

beam of heterogeneous X-rays falls on a single crystal. The lattice points in the crystal can be imagined as all lying on sets of parallel and equally spaced planes; there are an infinite number of such sets, but only a moderate number of them are sufficiently widely spaced to reflect X-rays of ordinary wave-lengths. Whenever a reflection takes place the relation $n\lambda = 2d \sin \theta$ must be satisfied, where λ is the wave-length, d the spacing of the set of planes, n is an integer,

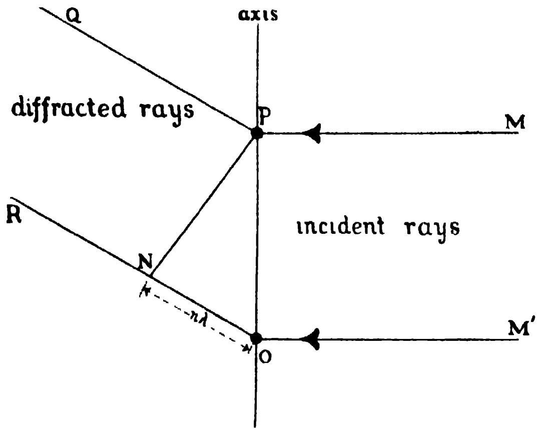

FIG. 2

and θ the angle between any plane of the set and either the incident or reflected ray. The well-known Laue photograph is formed by the reflections from the various sets of planes, each set reflecting that particular wave-length which it is able to reflect, according to the above equation. The arrangement of the spots on the photographic plate is closely connected with the symmetry of the crystal.

A second well-known type consists of a series of concentric rings; it is formed by reflections of rays of one wave-length—not mixed rays as in the previous case—which are incident on a mass of small similar crystals oriented in all directions. The explanation is that the reflection from a set of planes of given spacing must make a certain angle with the incident rays, but otherwise there is no condition which its direction must satisfy. Each ring is the aggregate of reflections from one such set. These ring photographs were introduced independently by Debye and Scherrer and by Hull, about ten years ago.

There is a third type which has been much used in recent years and is particularly important in view of the researches now under consideration. A small crystal is made to revolve about an axis perpendicular to a pencil of incident rays of one wave-length. The resulting photograph when the plate is also normal to the rays is of the character shown in Fig. 1, which is due to a sugar crystal. Each set of planes has its chance of reflecting during the revolution, provided that its spacing lies within certain limits. The spot which the reflection produces must lie on a certain circle concentric with the spot where the incident rays strike the plate; the same circle as that which was fully represented in the previous case when there was no limitation on the orientation of the crystal. But there is now a further condition; each spot must lie on one of a series of hyperbolas, such as are clearly

[1] Abstract of lectures delivered by the author at the Royal Institution on April 29 and May 6. The lectures were abbreviated on account of the industrial disarrangements of the time. It is proposed to give the lectures in full next November.

[2] The researches in this direction have been principally carried out in the Kaiser Wilhelm-Institut für Faserstoffchemie in Berlin-Dahlem by Herzog, Gonell, Mark, Weissenberg, and other workers. The photographic illustrations of this article are due to Mr. W. T. Astbury.

shown in the sugar photograph. This point is readily explained with the help of Fig. 2, which shows incident rays falling on two lattice points O and P, and diffracted rays passing away from these points. It is to be remembered that OP is extremely small in comparison with the size of the crystal, and this again is small in comparison with the distance from the crystal to the photographic plate. The incident and reflected rays are 'fine pencils,' though they contain an enormous number of such lines as MP, M'O. When there is

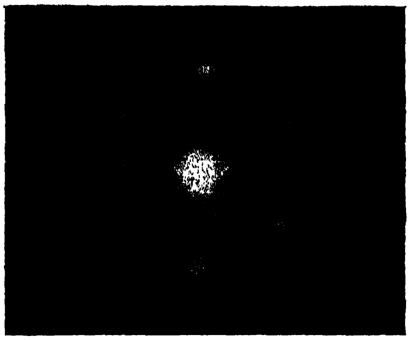

FIG. 3.—Asbestos. Bundle of fibres held steady. Homogeneous rays.

a diffracted or reflected ray from the crystal the contributions from any two such points must be in the same phase. Hence ON must be equal to $n\lambda$ where n is zero or an integer. If O and P lie on the axis of rotation, every diffracted ray must make with OP an angle $\cos^{-1} n\lambda/OP$. Thus all such rays must lie on one or other of a series of cones having OP as axis, and these cones cut the plate in a series of hyperbolas. If O and P are consecutive lattice points along OP, the first hyperbola is given by $\theta = \cos^{-1} \lambda/OP$. If θ is measured, OP can be calculated; and in this way the geometry of the lattice can be found.

A substance containing a number of small crystals having one direction in common, but otherwise oriented in a haphazard manner, gives the same photograph as a single crystal rotated about that direction during the exposure. Such a photograph is, for example, given by asbestos as shown in Fig. 3; the fibres have been set normal to the rays.

It is not often that a substance shows this arrangement in perfection, and gives a photograph like that of a single revolving crystal. Sometimes it is a spot photograph from which a number of spots are missing; it is like that of a single crystal which has not been turned through a full revolution. A bent flake of maleic acid (Müller, NATURE, May 22, p. 721) gives a photograph of this kind; if it could be bent so as to make a cylinder the tale of spots would be complete.

More often the spots are opened out into arcs of the circles on which they lie. A spot cannot move off its circle so long as the wave-length remains the same; but if there is any variability in the common direction of the crystals, the positions and spacings of the set of hyperbolæ are also variable, so that the spot broadens out along the circle on which it lies. The same effect would be obtained from a rotating photograph of a single crystal, if the axis of revolution were given some motion of its own, regular or irregular. The amount of extension of each spot into an arc varies from plane to plane, and much information can be obtained from a study of the photograph as to the possible variation in the orientation of each plane.

If there is complete uncertainty as to the orientation of the small crystals, that is to say, if there is nothing like a common direction, then a spot may lie anywhere on its circle, and we have again the ring photographs which Debye and Scherrer and Hull obtained independently.

Thus the type of photograph obtained by passing monochromatic rays through a substance shows the extent of the crystallisation. A single crystal gives no picture unless rotated. A substance containing many crystals, all having one direction in common, gives a photograph of spots, arranged in a series of hyperbolæ. The picture has symmetry about the projection of the axis on the plate; and if the incident ray is perpendicular to the axis and the plate, there is also symmetry about a line perpendicular to the projection. If there is only an approach to a common direction, the spots are drawn out into arcs of circles. If there is no approach at all, the circles are complete.

A spot never moves off its circle no matter how the crystals are oriented, so long as the rays are monochromatic. But if the rays are heterogeneous, the spot is drawn out to form part of a closed curve of a lemniscate form which crosses the circle. Photographs (Figs. 1 and 3) show traces of these curves, when the rays employed are not quite monochromatic.

The photographs of structures from several sources composed partly, sometimes almost wholly, of cellulose, all show the existence of crystals having the same lattice. Ramie (Fig. 4) gives quite a good spot photograph when the fibres are perpendicular to the rays; from which it can be concluded that one direction of the minute

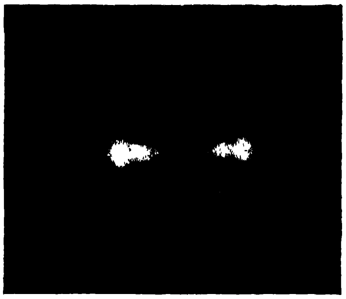

FIG. 4.—Ramie fibre. Homogeneous rays. Bundle of fibres held steady. The original photograph shows some thirty or forty spots, many of which are too faint to appear in the reproduction.

crystals is for all of them very nearly parallel to the fibre axis. It is possible, in fact, to calculate the size and form of the unit cell; the size turns out to be comparable with that of cells of ordinary organic substances. Clearly the unit of pattern does not contain the substance of many molecules, nor does each molecule contain many atoms (Herzog, *Naturwiss.*, 1924, p. 958). Cotton-wool, in the form of a small pad, gives rings, showing that its crystallites are in this case arranged entirely at random; but when a number of fibres are stretched parallel to one another there is some approach to a common axis. That the arrangement is not more complete has been ascribed to the fact that cotton fibres have a spiral structure.

It is of course no new idea that woollen, cotton and other fibres are two-phase systems at least. The elastic properties [3] point directly to such a supposition.

Mercerisation makes changes in the X-ray picture; the spots move perceptibly, but very little, and the relative intensities of some of them alter. It would appear that the general form of the lattice remains much the same, but there is some slight rearrangement of the atoms in the unit cell, perhaps an addition to them. (The cellulose photograph shows, too, that there is more than one crystalline substance present.)

Artificial silks show the structure of cellulose, as might be expected; though there are small differences in the intensities of different spots, depending on the method of manufacture. Brill has examined a number of natural silks from different sources and found the same structure in all of them.

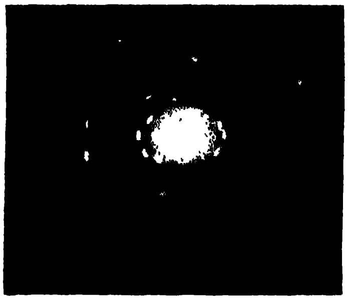

FIG. 5.—Spine of Arbacia. Laue photograph: rays heterogeneous, object held steady.

Herzog has examined chitin from various snails and insects, and found the same structure in them all. A very good spot diagram was obtained from a layer separated from the wing case of the Goliath beetle; the whole case, containing many layers, gave a blurred picture because the crystallites are not oriented the same way in the different layers.

In some cases the X-rays have confirmed previous suppositions, as, for example, that the spines of the sea-urchin consist of single crystals, or at least of aggregates of single crystals all similarly oriented in all respects, not merely in one direction (Fig. 5).

These will serve as examples of the application of the X-ray methods to various substances in the living organism. They are but a beginning, relatively few in number, and imperfectly understood.

In metallurgy the methods have been largely employed in the study of the gradual changes that take place during mechanical treatment. Rolling and drawing tend to give special orientations to the metal crystals. It has been shown by Wever, and by Owen and Preston, that in rolled aluminium foils the crystals finally arrange themselves so that (112) planes lie in the surface, a (111) direction being the direction of rolling (Fig. 6). The cube diagonals of the small cubic crystals lie in the surface; this condition is satisfied by two positions of the cubes, which are images of each other in the surface.

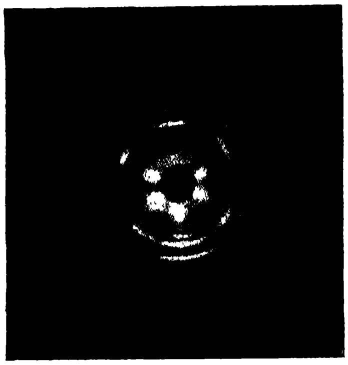

FIG. 6.—Aluminium foil rotated about an axis parallel to the direction of rolling [111]. Homogeneous rays.

The interesting point is that a certain tendency to orientation is a consequence of treatment which may be due either to mechanical handling or to some process of life. Absolutely irregular orientation cannot be generally consistent with purpose or design. Whenever small crystals exist in organic substances—and they are far more common than we have supposed—their arrangement is connected with growth, and they may be essential to it, or illustrate it, or be connected with it in some way or other which may be important to know. The X-rays show simply and conveniently the amount of any such regularity, and it is for that reason that it is interesting to apply them to a wide study of natural structures of all kinds.

[3] Shorter, *Journal of the Textile Institute*, **15**, 4, p. 207.

The Passing of Finsbury Technical College.

THE closing of Finsbury Technical College—familiarly known as "Finsbury"—on July 26, after an existence of nearly half a century, is an event which will be generally regretted. The College was founded in 1878 by the City and Guilds of London Institute, its object being specifically to train students in the principles of science as applied to industry. In this respect it was a new departure in English education, and great interest in its future was aroused both in academic and industrial circles. The courses of instruction were in applied physics, mechanical engineering (to which civil engineering was added later), and applied chemistry, the first professors being W. E. Ayrton, J. Perry, and H. E. Armstrong. A department of applied art, under the direction of Mr. A. Brophy, was attached, and from the beginning both day and evening classes were held in all subjects. The experiment was immediately successful, and in 1885 the Central Technical College at South Kensington—also founded by the City and Guilds of London Institute—was opened. Profs. Ayrton and Armstrong were transferred to the new establishment, and were succeeded by Silvanus P. Thompson and R. Meldola, both of whom held office for more than thirty years.

Thompson on joining the staff was made principal of the College, and threw all his energy into the work. Under his direction the reputation of the College rapidly grew, and students were attracted not only from different parts of the British Isles, but also from all over the world. The day students attended for two years, and received the College certificate on passing

the prescribed examinations. Special lecture and laboratory courses were arranged for evening students, many of whom made long train journeys to take advantage of the facilities afforded. No outside examinations were held, and within wide limits each member of the staff was permitted to teach what he thought best and most useful, instead of being tied down to an examination syllabus. Under this system Finsbury flourished, and the number of students increased to such an extent that further accommodation became necessary, and a new wing was added to the College in 1904, which included a large engineering laboratory equipped with modern machinery and commodious drawing-offices. It appeared at this date that Finsbury was firmly and permanently established; but in the ensuing years various difficulties arose which threatened this seeming security, and ultimately led to the closing of the College.

The first troubles were financial. The amount available for Finsbury depended mainly upon voluntary subscriptions to the Institute from the City Companies, which were in some cases reduced in order to provide for special activities on the part of the companies concerned. The development of the College was greatly impeded by the absence of much-needed funds at a time when competitive establishments, often financed from public sources, were being organised in London and other parts of England. Temporary relief was afforded by the closing of the Art Department; but Finsbury was unable to keep so far ahead of its rivals as to attract a full complement of students from all quarters, and about 1910 a notable fall in the number of entrants, both day and evening, occurred. A contributory cause, in the case of day students, was the extension of the course to three years in order to conform with new regulations for admission to membership of the professional institutions.

At this stage the College also began to suffer from the increasing importance attached by public bodies, and even commercial companies, to the possession of a university degree, for which no provision could be made without fundamentally changing the character of the instruction. The War, with the greatly increased cost of upkeep which supervened, added further to the financial difficulties, and a great loss was sustained by the deaths of Profs. Meldola and Thompson during the War. In 1920 it was announced that the College was to be closed, and no new students were admitted in that year. As the result of a widespread agitation the London County Council offered financial aid for a period of five years, and in 1921 new students were again enrolled. The numbers joining, however, were not considered sufficient by the County Council to justify a continuation of the grant, and as the necessary sum was not forthcoming from any other source the closing of the College became inevitable.

Such, in brief, is the life-history of Finsbury; but a few words are needed to explain why it became well known all over the world. The two chief causes were an efficient and enthusiastic staff, from the principal down to the laboratory boys, and a true research atmosphere which infected the students and contributed largely to the great success they achieved in all branches of applied science. Amongst members of the staff who attained to the distinction of F.R.S. were the five early professors already named and Profs. Dalby, Coker, Morgan, and Eccles. Many important researches in applied science were carried out at Finsbury, such as the early work of Mrs. Ayrton on the electric arc; of Ayrton and Perry on electrical measuring instruments; Thompson on X-ray targets, cathode rays, and various electrical and optical devices; Meldola on dye-stuffs; Dalby on the balancing of engines; Coker and Scoble on the optical method of investigating stresses in materials and on the temperatures prevailing in the cylinders of internal-combustion engines; and Eccles on various radio devices, including the valve-controlled tuning-fork.

All these researches were fundamental, and will in themselves preserve the name of Finsbury; but a much longer list could be compiled dealing with researches in many branches of physics, engineering, and chemistry conducted by other members of the staff. It will no doubt be possible easily to distribute the students who would have attended Finsbury among other institutions, but it will not be easy to establish everywhere they may go the atmosphere of enthusiastic work and inquiry which characterised the College and brought out the best that was in the students. It has been said that the usual fate of successful reformers is to render themselves superfluous; and Finsbury, which set out to reform technical education and succeeded, has had this fate forced upon it by adverse circumstances. Whilst its demise must be deplored, it will be a satisfaction to all who have been connected with the College in any capacity that it has made for itself a lasting name in the annals of British education.

C. R. D.

The Oxford Meeting of the British Association.

OXFORD is in many respects a centre well-suited for meetings of the British Association for the Advancement of Science. It is easy of access from most parts of the country; it is well provided with accommodation for persons with moderate requirements; it is situated in a neighbourhood full of interest both historical and natural; and lastly, in its University lecture-rooms and laboratories it is able to furnish most of the conditions needed for the scientific business of the various sections.

In one particular Oxford is at a disadvantage compared with many of the places which have extended their hospitality to the Association—it is deficient in buildings large enough to collect all the members attending the meeting under one roof. It will not be possible in Oxford for even half of those who wish to do so to see and hear the Prince of Wales deliver his presidential address in his own person. The largest hall in the University—the Sheldonian Theatre—will not accommodate more than about 1500, and of these the large majority will have to submit to the discomfort of seats without backs. Conditions in the Town Hall, which has been put at the disposal of the Association by the civic authorities, are somewhat better adapted for an audience with present-day notions of comfort; though it will accommodate no larger number than the

Theatre where the address will be actually given. It is hoped that the Prince, at the conclusion of the business in the Sheldonian, will be able to visit the Town Hall, to which building his address will have been relayed. A further relay has been arranged to the debating hall of the Union Society, and in this way provision will have been secured for every one to hear the words of the president, and for nearly every one to see him.

The fact of the meeting taking place in Oxford will recall to the minds of many the records that exist of the famous meeting of 1860, which was especially signalised by the caustic reply of T. H. Huxley to the criticism passed by Samuel Wilberforce, then Bishop of Oxford, on the Darwinian theory of evolution—at that time a startling, and to the majority an unpleasant novelty. The scene of this memorable encounter was the northern section of the first-floor room in the front of the University Museum, part of which room is now occupied by the Hope Department of Entomology. To those who, like the present writer, heard the presidential address of the late Marquis of Salisbury at Oxford in 1894, there was something peculiarly impressive in the calm and measured language in which one of the former protagonists, Huxley himself, commented on an address which contained the words, "[Darwin] has, as a matter of fact, disposed of the doctrine of the immutability of species." The stage on which this latter development of the drama was played was the same as that which will witness the address of this year's president, namely, the Sheldonian Theatre. It was here, also, that the Marquis of Salisbury, on the occasion referred to, as Chancellor of the University, imparted a pleasantly light touch to the proceedings by introducing and welcoming himself as president of the British Association.

Oxford has, however, scientific associations of an earlier date. It will doubtless be remembered by many of the visitors that it was the scene in the thirteenth century of the labours and researches of Roger Bacon, the great Franciscan who, as the unflinching advocate of experimental science as against authority, was held by Humboldt to be "the most important phenomenon of the Middle Ages." [1] Perhaps some of the members of the Association will be able to find time to visit the traditional site of Roger's workshop at Folly Bridge, and the memorial tablet lately affixed to the old City Wall in close proximity to the spot where he is known to have been buried.

In Sir Archibald Geikie's happy phrase, "if Oxford was not present at the birth of the Royal Society, it at anyrate rocked the cradle of the infant." In these words he was referring to the account published in 1667 by Dr. Thomas Spratt of the meetings held "in *Dr. Wilkins* his Lodgings, in *Wadham College* (1648–59), which was then the place of Resort for Vertuous, and Learned Men." These meetings, says Spratt, in his History of the Royal Society, "laid the foundation of all this that follow'd." "By this means," he adds, "there was a race of yong Men provided, against the next Age, whose minds receiving from them [*i.e.* the men who met under Wilkins's auspices], their first Impressions of *sober* and *generous Knowledge*, were invincibly arm'd against all the inchantments of *Enthusiasm*." [2]

It need scarcely be said that the last word cited did not bear for the men of that time precisely the same meaning that belongs to it at the present day. Among the "principal and most constant of those who met at Wadham," Spratt enumerates the names of Seth Ward, the astronomer; Willis, the instructor of Lower and Mayow; Hooke, Robert Boyle, Sir William Petty, and "that miracle of a youth," as Evelyn calls him, Christopher Wren. The earliest experiments on transfusion were carried out in Oxford by Lower at the suggestion of Wren; and it is worthy of note that Sydenham, the great physician, and Mayow, the actual discoverer of oxygen and of the chemical and physiological explanation of combustion and bodily heat, were, besides Wren, all members of Wadham College, the institution presided over by the scientifically-minded brother-in-law of the Protector, spoken of by Evelyn as "that most obliging and universally-curious Dr. Wilkins."

The interest in 'natural knowledge' thus set going in the middle of the seventeenth century finds no abatement to-day; and those who will take the opportunity of the forthcoming meeting to make themselves acquainted with the scientific equipment and appliances now to be found in Oxford, will not fail to gain the impression that this ancient seat of learning is fully determined to take her proper part in the scientific progress of the present and future ages.

F. A. D.

[1] NATURE, June 18, 1914, p. 405.

[2] Italics and spelling preserved as in the original text.

The Ross Institute and Hospital.

OPENING BY THE PRINCE OF WALES.

NO ceremony relating to the health and welfare of the British Empire has attracted so wide an interest as the opening of the Ross Institute and Hospital for Tropical Diseases by H.R.H. the Prince of Wales on July 15. It was the outward and visible sign of the initial success of a movement started more than three years ago to found a Ross Institute for Tropical Diseases which should include a Research Hospital. That movement had several objects in view, namely, to do honour to Ross while living for his epoch-making discovery of the method of transmission of malaria to human beings, to commemorate for all time his great achievement, to further the much-needed work of research in the prevention and treatment of tropical and sub-tropical diseases, to create a more general professional and public interest in the prevention and treatment of tropical diseases throughout the vast possessions of Great Britain in the tropics, and to assist medical men to carry out research work.

It has long been the complaint of some of the most promising men in the tropics that there was no institute in London where they could have the facilities when at home for research work on any special subject that had interested them in the tropics, which they desired to pursue further in their leisure time. The Ross Institute will now help them. France has her Pasteur

Institute in memory of her great man of science and to carry on his work. America has her Gorgas Institute at Panama, Japan has her Kitasato Institute, London has now her Ross Institute and Hospital for Tropical Diseases, the president of which is the Duchess of Portland, the chairman, Sir Charles McLeod, Bart., and the vice-chairman, Mr. Walter Shakespeare. There is a strong executive committee and council. The present medical officers are Sir Ronald Ross, director-in-chief, Dr. Castellani, director of tropical medicine and dermatology, and Sir William Simpson, director of tropical hygiene. Sir Ronald is still hale and hearty, and it must have been a source of gratification to him that, twenty-nine years after his famous discovery, and when the application of it is universally acknowledged to have resulted in the saving of an enormous number of lives and made some formerly uninhabitable places habitable, to have this Institute bearing his name opened by the Prince of Wales, who was the first to give a lead to the appeal for the necessary funds which was made in the *Times* of June 23, 1923.

The building, which contains two hospital wards, three laboratories, a library, and nurses' quarters, is not large, but it is on a healthy site facing Putney Heath, and the grounds are sufficiently extensive to allow of great additions in the future.

The Prince on his arrival at the Institute was received by the president, the Duchess of Portland, and the chairman, Sir Charles McLeod. A number of presentations were made to His Royal Highness, who afterwards inspected the wards, laboratories, and library, and then proceeded to the dais reserved for him and facing a pavilion in which more than six hundred guests were assembled. Here the chairman, Sir Charles McLeod, presented an address to the Prince in which he mentioned that His Royal Highness on his visits through different parts of the Empire and in foreign countries had landed on many tropical shores, and that his interest and sympathy cannot but have been aroused by the record of the decimating scourge of diseases incidental to these latitudes. Many of these diseases still hold the field but, thanks to Sir Ronald Ross, in honour of whose discoveries this Institute was founded, one of the greatest of them—malaria—has been or can be practically overcome. Sir Charles described the objects of the Institute, the chief of which is by research into causes of diseases to lessen the burden which weighs so heavily on labour and industry, and still more terribly on human life, in tropical and sub-tropical lands. Great strides in the knowledge of tropical diseases have been made during the last quarter of a century, and there is every hope and encouragement that in the quest and exploration of still unknown regions in medicine it will be possible to add to the stores of that science which aims only at conferring benefits on all human beings. The Prince was then presented by Sir Charles with a golden key, on which was a colour impression of the Ross Institute, and asked to declare the Institute open.

The Prince of Wales in rising to speak was received with great enthusiasm, and said :

"The opening of this Institute, which I am very glad to perform, commemorates a definite achievement in the work which the British Empire has done for civilisation. Not the least important obligation which the development of that Empire has laid on the members of our race is the constant struggle against disease in all the varied forms it can assume in different climates and in different latitudes. The struggle is always fiercest in the tropics, where man, and especially the white man, is the continual prey of diseases from which we in this country are, comparatively speaking, protected by a more temperate climate ; and perhaps the saddest page in the whole history of our Empire is that which tells of the terrible toll taken by plague and by fever of those who helped to build it.

"Of all these tropical enemies, malaria has probably been the most deadly and elusive. But now, thanks to the achievement of one man, whose name we are perpetuating in this Ross Institute, its ultimate defeat is certain. Only a few months ago I was able to see in the Sir Alfred Jones Laboratory in Sierra Leone not only the vital need for a campaign against malaria, but also the remarkable progress which has already been made in it. Perhaps I am biassed by many visits to tropical and sub-tropical parts of the world where malaria is rife, and by having talked with so many men and women whose health has been shattered by a life's work in such districts, but I can think of no other single discovery in recent times which will earn the deep gratitude of so many thousands of human beings of all nationalities as the discovery made in India by Major Ronald Ross—as he was then—on August 20, 1897. The story of its subsequent development and of what it has led to is well known to you all. I need only summarise it in the words of a famous writer : 'It is not too much to say that Sir Ronald Ross has made one-third of the world inhabitable.'

"Over a quarter of a century has elapsed since that epoch-making discovery, and this institute and hospital now stands as a memorial to the life-work of Sir Ronald and his colleagues. But it is not merely a passive memorial to work accomplished in the past ; it is also, as Sir Charles McLeod has reminded us, a very active centre for work to be done in the future. All who have any experience of the tropics will know that there is still a vast field for scientific medical research, and here, with all the resources that modern science can provide, such research can be effectively carried out, provided adequate funds are forthcoming. From this building may issue results which will bring back health to thousands who have lost it, or safeguard the lives of countless others threatened by unseen dangers in tropical lands. More than that, it may open out for the use and benefit of mankind as a whole, huge districts which are at present denied to civilisation.

"It is not surprising, therefore, that, when the scheme for founding this Institute was first put forward, it immediately received widespread public support. That support happily made its inception possible, and once the first financial obstacle was surmounted, its promoters lost no time in making it a reality. To the president, the Duchess of Portland, to Sir Charles McLeod and Mr. Shakespeare, and to Sir Ronald and his two co-directors, Sir William Simpson and Dr. Castellani, the gratitude of all of us is specially due for the time and energy they have devoted to its execution. They and their fellow-officers of the Institute may well feel proud of the result of their labours and of the knowledge that they have called into being something which cannot fail to be of incalculable benefit to many generations.

"It is with the sincere hope that further public

support for the necessary endowment may be forthcoming, and that the labours of those who will work here may be blessed with every success, that I now declare the Ross Institute and Hospital open."

After the Bishop of Southwark offered a dedicatory prayer, a vote of thanks to the Prince was proposed by the Duchess of Portland, and seconded by Sir Ronald Ross, who expressed his grateful thanks to the Prince for the kind manner in which His Royal Highness had referred to his work. He also thanked all the contributors for the honour they had done him in naming the Institute after him. The Prince replied to the vote of thanks, and after his departure the Institute was opened to the inspection of the guests.

News and Views.

ON July 14, in the House of Lords, the Duke of Northumberland directed attention to the alteration in the status of the engineer officers of the Royal Navy brought about by the Admiralty Fleet Order 3241/25 issued last November. This matter has already been referred to in these columns on several occasions. In his remarks the Duke of Northumberland said that the Order abolished the last vestige of the improved status of the engineer officer under the 1902 scheme for the amalgamation of the engineering branch with the deck officers. Not only did it relegate the engineer officer to the non-executive branch of the Navy, but it also emphasised the distinction between the deck officer and the engineer officer by re-imposing the wearing of the purple stripe. The Duke of Northumberland was supported by Viscount Chelmsford and the Earl of Selborne, the latter remarking that the point of view of the engineer officers had been recapitulated by Engineer Rear-Admiral Sheen in a letter in the *Times* of June 1, and to that he had seen no answer. Moreover, the Order might do great harm and could do no possible good. Viscount Chelmsford said that the question had arisen when he was First Lord and he had left a personal note for his successor, Mr. Bridgeman, to the effect that there had been no acute demand for the change, and that the system as it then stood was working well. The Duke of Montrose also spoke. He seemed to think that because purple had been worn by emperors, engineers should not object to it. The answer to that is, of course, that it is the way it has been imposed and what it signifies that renders it so distasteful. With his suggestions that engineer officers should have executive command of certain establishments ashore and that an engineer officer should be appointed a Sea Lord of the Admiralty a good many will agree.

THE reply for the Admiralty was made by Earl Stanhope, who repeated Mr. Bridgeman's assurance that the Order did not affect the ranks, titles, and powers of engineer officers. That, however, is not correct, for the Order does undoubtedly take away the power of engineer officers to rise to certain high appointments which they could have reached as executive officers. Earl Stanhope said that the Order was designed to sweep away an anomalous position, and divided all officers into categories according to their duties. He did not say, however, why there should be three categories of engineer officers—one for the main machinery, one for the gun machinery, and one for the electrical machinery, while navigating, gunnery, and torpedo officers all remained in one category. Such a reply will give no satisfaction in engineering circles, and does nothing towards removing that sense of injustice from which engineer officers are suffering. In view of the apparent determination of the Admiralty to stand by this Order and to impose the purple stripe, we think the Joint Committee of the Engineering Institutions, of which Sir William Ellis is chairman, would do well to issue a short plain statement of the matter as it now stands. The excellent memorandum issued some months back was too long for general distribution, and in the highest interests of Great Britain this is a matter for the widest publicity.

ON July 22 the centenary occurred of the death of Guiseppe Piazzi, the discoverer of the first of the minor planets. Piazzi was born in the north of Italy in 1746, and came under some of the most distinguished teachers of his day. He then entered the monastic order of the Theatines. A professor first at Genoa and then in Malta, in 1780 he was appointed to a chair of mathematics at Palermo. His efforts to found an observatory there were seconded by the Viceroy of Sicily, Prince Caramanico, and the observatory was opened in 1791. Piazzi meanwhile had studied Lalande's methods in Paris and Maskelyne's at Greenwich, and when he returned to Palermo in 1789 he had among his instruments a 5 ft. vertical circle by Ramsden. He devoted himself to the preparation of star catalogues, and it was while pursuing this work that in January 1, 1801, he discovered Ceres, named thus in allusion to the titular goddess of Sicily. He communicated his discovery in the first place to Oriani, who calculated the elements of its orbit, and then to Bode. Piazzi's star catalogues were published in 1803, 1807 and 1814, the latter containing 7646 stars. He served for some time as president of the Academy of Sciences of Naples, and was elected a foreign member of the Royal Society of London. By his will he bequeathed his library and instruments to the observatory at Palermo, and left an annuity for educating students in astronomical science.

THE news of the impending retirement of Prof. J. A. Fleming from the chair of electrical engineering at University College, London, a position which he has occupied since its foundation in 1885, will be received with regret by the large number of friends and students who have come under his influence. His tenure of office has been practically co-extensive with the growth of modern electrical engineering, a development in which he has taken a great part. So early as 1879 he was the scientific adviser of the original Edison Telephone Company of London, and in 1882 he was appointed to a similar position with

the Edison Electric Light Company of London, taking part in the establishment of the first electric supply stations. In 1890 he acted in the same capacity for the London Electric Supply Corporation, formed to operate the Ferranti system of high voltage electric supply, using single-phase alternating current. In '99 he was retained by Marconi's Wireless Telegraph pany to advise on the engineering work in connexion with the establishment at Poldhu of the first high power radio station in the world. Prof. Fleming has thus been in intimate touch with the early development in Great Britain of the three important electrical inventions: the telephone, the electric incandescent lamp and radio communication. During the forty-one years of his teaching work at University College, about 2000 students have passed through his department, many of whom have since achieved great distinction, there being among them three who have become presidents of the Institution of Electrical Engineers. His interest in general education has shown itself in the prominent part which he took in the work which led to the foundation of the Morley Memorial College.

PROF. FLEMING'S original contributions to knowledge are comprised in rather more than a hundred papers published in the transactions of various learned societies and covering such matters as the direct reading potentiometer, the investigation in conjunction with the late Sir James Dewar of the electric and magnetic properties of matter at low temperatures, a paper read before the Institution of Electrical Engineers in 1885 on the necessity for a National Electrical Standardising Laboratory, which gave the first impulse to the movement that resulted in the establishment of the National Physical Laboratory, and the invention of the thermionic valve, which in its modernised form is the essential element in radio communication. He is the author of a large number of very widely known text-books on electrical subjects. He was elected a fellow of the Royal Society in 1892 and received the Hughes Medal of the Society in 1910. The Royal Society of Arts awarded him its Albert Medal in 1922, especially for his invention of the thermionic valve. The Institution of Electrical Engineers has awarded him its Institution premium on two occasions, and made him an honorary member in 1923. His membership of other societies includes that of the Society of Engineers of London, the Glasgow Philosophical Society and honorary membership of the Royal Engineers' Institute, Chatham. Prof. Fleming's great gift of clear exposition and successful experimenting has created for him a special place as a public lecturer, as the audiences whose attention he has held on very many occasions at the Royal Institution have testified. He carries with him into his retirement the sincere good wishes of a large circle of friends, colleagues and students.

IN his address to the tenth annual meeting of the Association of British Chemical Manufacturers, held on July 8, Mr. D. Milne Watson, the chairman, dealt with recent activities of the Association and certain topical events, such as the coal strike, from the point of view of the chemical manufacturer. The British chemical industry may be comparatively small, yet it is advancing: during the decade 1911–21 the number of persons engaged in it increased from 0·81 to 1·15 per cent. of the total number of occupied persons in the country. Although rather jaded with fairs and exhibitions, the Association has supported the revived British Industries Fair; the view is held that chemical firms should not, as a rule, exhibit individually or indiscriminately, but unitedly as an industry at selected exhibitions. Whatever views may be held on the policy of protection, there is no doubt that the careful survey of an industry prior to legislating, such as was recently carried out in connexion with the extension of the Safeguarding Act to the fine-chemical industry for a further period of ten years, is very stimulating to the industry; on the other hand, care is needed to prevent a protected industry from becoming lethargic.

REFERENCE was also made in Mr. Watson's address to the harm done in recent years by viewing the dyestuffs industry through magnifying glasses. This industry suffers from fierce competition abroad, and from an excess of plant left over from the War. The contention that it has a secure home market is only a half-truth, for security is only given when a dyestuff is equal in quality to a competing foreign one, and when it is sold at a price which does not place the user in an unduly disadvantageous competitive position. Consolidation of interests, such as has been effected between Scottish Dyes, Ltd. and the British Dyestuffs Corporation, and between British Synthetics, Ltd. and the British Alizarine Co., is advisable and should be extended; and the lines upon which industrial development is proceeding in other countries must be studied with the view of introducing changes in the organisation of British chemical industry. The council of the Association does not see how it can take any effective or direct part in negotiating a settlement of the coal strike, but it is co-operating to that end with other industries under the ægis of the Federation of British Industries. So far, chemical manufacturers have been able to maintain stocks and to meet all demands. The fact that during the general strike only a very few employees in the chemical industry left their work is ascribed to the cordial relations which have always subsisted between masters and men, and to the circumstance that the men are for the most part really interested in their work.

IN the discussion on the chairman's address, Dr. E. F. Armstrong emphasised the need of more effective co-operation among home-producers, and also the undesirability of building up sections of the industry "which are strong because they are members of international groups, in which the British voice varies in loudness." All indications point to foreign competition becoming more fierce. The Right Hon. J. W. Wilson referred to the magnitude of the German Interessengemeinschaft and to the even greater combination in the iron and steel industry; although

the United States will probably follow suit, this line of development is not in accordance with the British temperament. Dr. G. C. Clayton, M.P., has noted the increased attention paid by the House of Commons to chemical matters, while the Government is showing considerable interest in the Department of Scientific and Industrial Research. He regards recent results obtained in the Fuel Department as hopeful, and thinks that before long an economic process for recovering the valuable products from coal and for producing smokeless fuel will see the light of day. The Germans claim that they have overcome most of the difficulties in producing liquid fuel direct from coal; we in Great Britain are not very far behind them, if, indeed, we are not actually in front.

THE annual meeting of the Society of Chemical Industry and Congress of Chemists, in which a number of societies with related interests are co-operating, opened on Monday, July 19, and in the afternoon the Messel Memorial Medal was presented to Lord Balfour by the Duke of York. After the presentation, Lord Balfour delivered the Messel Memorial Lecture, taking as his subject the relation of the State to science and industry. In tracing the association between science and industry, Lord Balfour referred first of all to the men of genius, moved solely by the desire to add to the store of human knowledge, to whom falls the glory of making fundamental discoveries. This work can be stimulated only by education. The next stage is accomplished by men of constructive ability who can see how the achievements of the scientific worker are to be applied. Then comes the time for testing the results on a scale larger than that of the laboratory experiment, and finally there is the full scale trial which, if satisfactory, means that another piece of laboratory work has been applied to the purposes of industry, and the organisation of production and marketing can proceed. A Government department can do little to further fundamental discovery and should not interfere with the last stages of development, namely, production and marketing. Its assistance should be given, Lord Balfour stated, in the middle region, where industry as a whole rather than one special branch is concerned. There has been no falling-off in the achievements of British men of science or in the business capacity of the leaders of industry, but more co-operation is needed between them, coupled with the broad and imaginative outlook which has been the basis of the great industries in other countries of the world.

IN the course of an address delivered by Sir Robert Hadfield on the occasion of the opening of new metallurgical and engineering research laboratories during the twenty-first anniversary celebrations of the University of Sheffield, the speaker reviewed the history of the University and its predecessors, the Firth College and the Technical School, and of the efforts made to establish educational facilities in connexion with the industries of the city. Although Sheffield had been for many centuries an important centre for the manufacture of steel by the old methods, it was not until the invention of crucible steel by Huntsman in 1740 that it began to assume the leading position which it has occupied ever since. It is remarkable how, the manufacture of steels of specially high quality having once been established, the existence of a skilled body of workers, and of manufacturers accustomed to the trade, favoured the introduction of new processes, so that a large number of important inventions, especially concerning alloy steels, have originated in that city. It is also appropriate that the study of metallography, which may be said to have furnished the scientific basis for all modern metallurgy, should owe its origin to a Sheffield scientific man, H. C. Sorby, a pioneer in so many branches of science. The new laboratories are equipped for the investigation of metals, and particularly of steel, by modern physical methods, in view of the remarkable results which have been attained by the application of exact physical measurement and by the study of physical properties in the improvement of metallurgical operations.

SIR ROBERT HADFIELD's address contains statistics concerning the work of Sheffield firms during the War, when the great armament plants were largely increased and enormous quantities of munitions were produced. Statistics as to present employment show the number of employed persons to be about 184,000, of whom, roughly, 42,000 are engaged in the iron and steel industry and 21,000 in cutlery, to name the two occupations most usually associated with the city. The importance of education and training for these industries is therefore obvious, and the University has set itself to meet the needs of the local population, whilst at the same time becoming a centre of post-graduate study and research. In view of the situation on the South Yorkshire coalfield, the study of coal also assumes great importance, and the Fuel Department of the University has been specially equipped for research on the utilisation of coal. One of the urgent needs of the industry is the greater application of electrical power, and interesting facts bearing on this subject are quoted by the author. Even with the existing comparatively high cost of electric power, its use in the steel industry has assumed vast dimensions.

THE fifth Hurter and Driffield Memorial Lecture was delivered by Prof. Charles Fabry before the Royal Photographic Society on April 20 last, and is published, with illustrations, in the July issue of the Society's journal. Prof. Fabry took as his subject "The Photographic Plate as an Instrument for the Measurement of Visible and Invisible Radiations," and passed in review probably all the useful methods of photographic photometry, indicating their respective advantages, difficulties, and limitations. The use of polarisers for varying the intensity of the incident beam is excellent when the light is not partially polarised, but the layer of Canada balsam present in most polarisers is absolutely opaque to ultra-violet radiations of wave-length less than 3400 Å.U. Beyond this the balsam may be replaced by air, but this gives a small angular field. Prof. Fabry adds, "I have, however, used Glan prisms with success." When

working in the ultra-violet region in conjunction with M. Buisson, it was found that the stripped gelatine film (glass being inadmissible because of its absorption) of a developed plate gave a sudden diminution of its absorptive power, transmitting about twelve times as much light at 3150 Å.U. as at a little distance on either side of this point, due to the transparency of metallic silver for radiations of about this wave-length. This difficulty was overcome by intensifying the plate with mercuric chloride and ammonia before stripping. Schumann plates are not suitable for photometric purposes because of the irregularities following from the difficulties of their manufacture, but the 'oiled plate' introduced by Duclaux et Jeantet is spoken of as perfectly suitable. A thin layer of mineral oil put upon the plate fluoresces in the ultra-violet and the fluorescent light affects the plate. An illustration shows the effect with and without the oil for wave-lengths from about 2816 to 1854 Å.U. Prof. Fabry urges the desirability of founding one's photometry on the energy (or heating power) of radiations, as this is " the only real measure of the intensity of a radiation." " Two rays which appear equal with a certain exposure may seem to be absolutely different if a longer exposure is given "

A SERIES of postcards depicting objects of scientific interest preserved in or connected with the Old Ashmolean Museum has recently been issued by the Oxford University Press. The collection comprises a set of designs representing the Old Ashmolean at different dates, including a reproduction in colour of a print by Rowlandson (1809). Another set, devoted to the Dodo, begins with an excellent coloured copy by Mrs. Gunther of the well-known picture in the Sloane Collection, and is continued by De Bry's representation of the landing at Mauritius in 1598, by the drawings of Clusius and Savery, and by photographs of the head still preserved at Oxford. An interesting series of portraits starts with Richard of Wallingford, Merton College (1292–1336), the first describer in detail of the making of scientific instruments, and ends with John Evelyn, Balliol College (1620–1706). Other notable portraits are those of Robert Recorde, All Soul's College (1510–1548), the inventor of the mathematical signs of multiplication and equality, Robert Boyle, Elias Ashmole, Christopher Wren, and John Wilkins, the last two of Wadham College. In a set representing the history of medicine occurs a drawing by Christopher Wren of the base of the brain, which for exactness of detail could scarcely be bettered at the present day.

SINCE the quantum theory of spectrum emission was started on its career by Bohr in 1913, the stream of contributions by workers in all parts of the world has been almost unparalleled in its volume and variety of character. The, as yet, semi-empirical character of the whole conception gives the widest possible scope to speculation and the formation of arbitrary practical rules, and such rules have for some time been put forward at too rapid a rate for the controlling factor of experiment to separate the false from the true. The subject has consequently become so intricate and so charged with ideas, many of which are incompatible with one another, that the experimenter who has wished to obtain a clear idea of what is being proposed has had no time left for his experiments. In particular, the notations and numerical values assigned to the various 'quantum numbers' now recognised are almost as numerous as the writers on the subject, and the resulting confusion, which is largely unnecessary, has been a serious hindrance to the acquiring of definite ascertained knowledge. The appearance of a new *Bulletin* of the National Research Council of the National Academy of Sciences, Washington, on " Quantum Principles and Line Spectra," by J. H. Van Vleck, assistant professor of physics in the University of Minnesota (Washington, D.C., National Academy of Sciences, 1926, 3 dollars), in which the many-sided activities of theoretical workers are ably summarised and compared with one another, is therefore an event of great importance. Duplication of Sommerfeld's " Atombau und Spektrallinien " has been avoided so far as possible, and particular prominence is given to the methods of approaching the subject which are suggested by Bohr's correspondence principle. The volume has been brought up-to-date during passage through the press by the insertion of numerous footnotes, and may really be said to be invaluable to the large body of workers in spectroscopy. The author is to be commended on the clearness of his exposition. Each sentence has usually only one possible meaning—a characteristic which is far too rare in many of the original papers on the subject.

ROTHAMSTED Experiment Station appears to have made a new departure in the issue, in very attractive form and under the general title of " Rothamsted Conferences, I.," of an account of a recent discussion at Rothamsted upon the growing of lucerne. This little memoir is extremely effective. The case for a further cultivation of lucerne in Great Britain is first presented by Sir John Russell and members of his staff. Experience with lucerne is then given by members of staff from various experiment stations, by private growers, by big seedsmen, etc. Lord Bledisloe, Parliamentary Secretary to the Ministry of Agriculture and Fisheries, and Lord Clinton, chairman of the Lawes Agricultural Trust Committee, contribute, as also Mr. Dampier Whetham of the Royal Agricultural Society Research Committee. This committee has helped financially Mr. H. G. Thornton's experiments upon inoculation by *Bacillus radicicola*. A summary of points collected at the conference follows upon the discussion and makes a very clear presentation of the main case for lucerne growing. It appears that lucerne has often been a failure because British soils are not infested with the strain of the nodule nitrogen-fixing organisms necessary for its healthy growth. Mr. Thornton's field trials suggest that the difficulties in the way of successful inoculation often met with in the past are now overcome and lucerne then deserves a more extended trial. It will not grow on ill-drained or shallow soil, and probably requires a fair supply of lime; it must be sown on clear land and the weeds

kept down by suitable cultivation. Given these conditions, it is apparently one of the most valuable of arable crops, and adds to the fertility of the soil, permitting a more intense farming. It gives each year after the first year usually two good hay cuts and a green aftermath for cutting or grazing.

THE Council of the Royal Meteorological Society has awarded the Howard Prize for 1926 to Cadet B. W. Harman, of H.M.S. *Worcester*, for the best essay on "The Causes and Distribution of Fog in the North Atlantic."

DR. W. H. GIBSON has been appointed Director of Research for the Linen Industry Research Association in succession to Dr. J. Vargas Eyre. Dr. Gibson was educated at University College, London, under Sir William Ramsay, and afterwards spent twelve years at the Research Department, Royal Arsenal, Woolwich; for his services in connexion with high explosives research during the War he was awarded the M.B.E. in 1918 and the O.B.E. in 1920. For the last seven years he has been in charge of the Research Department of a prominent linen firm in Belfast.

EXCAVATIONS on prehistoric sites in the Crimea are about to be commenced under the auspices of the Russian State Academy for the History of Material Culture by G. A. Boutch-Osonolovsky. The first site to be attacked is the Kik-Koba cave, where it is hoped may be discovered missing parts of an early human skeleton already found. Exploration will then be extended to the hill caves of later palæolithic age in continuation of the investigations which were begun in 1924.

IT is stated in *Science* that, at the annual meeting of the Geological Society held at Peking on May 3-5, the first presentation was made of the Grabau Medal, founded by Mr. C. Y. Wang for "accomplishment in the field of geological research in China, or for original advancement of the science throughout the world." This first award was made to Prof. Amadeus W. Grabau, who has been largely responsible for the training of an active group of young Chinese geologists and has himself contributed to our knowledge of the invertebrate fossils and palæogeography of China and Central Asia.

THE secretary of the Department of Scientific and Industrial Research announces that a licence, under Section 20 of the Companies (Consolidation) Act 1908, has been issued by the Board of Trade to the British Food Manufacturers' Research Association, which has been approved by the Department as complying with the conditions laid down in the Government scheme for the encouragement of industrial research. The secretary of this Association is Mr. R. M. Leonard, 22 Buckingham Gate, London, S.W.1. The investigations of the Association will be conducted in close co-operation with those of the British Association of Research for the Cocoa, Chocolate, Sugar, Confectionery, and Jam trades.

PROF. H. H. BARTLETT, Director of the Botanical Gardens of the University of Michigan, who has just been appointed honorary collaborator of the Smithsonian Institution, is about to make collections of the flora of Sumatra and Formosa for the Smithsonian Institution and the University of Michigan. The flora of Sumatra, which is exceptionally rich from the scientific point of view as well as economically important, is poorly represented in the United States collections. During a year previously spent in studying the rubber-producing plants of Sumatra, Prof. Bartlett's attention was attracted to the folklore of the poorer Malays, and especially to their custom of writing beliefs, legends, and descriptions of the magical and medicinal properties of plants on the internodes of green bamboos which are afterwards dried and preserved. This folklore has received little attention hitherto. Prof. Bartlett proposes to devote some part of his time to the study of it as well as the language during his stay in the island.

REFERRING to the review entitled "Eugenic Reform" in NATURE of July 10, p. 39, Mrs. C. B. S. Hodson writes stating that her share in Major Leonard Darwin's book "The Need for Eugenic Reform" was confined merely to proof-reading for the detection of printer's errors.

UNDER the title "Instructions to Collectors: No. 7—Blood-sucking Flies, Ticks, etc." (1926: price 6*d*.), the British Museum (Natural History) has issued a fifth edition, revised and enlarged, of a useful illustrated pamphlet. The Museum requires carefully collected and properly labelled material of this kind from practically all parts of the world. Medical men and others who may be willing to help in the collection of specimens will find within its pages full directions for the collecting, mounting, and transmission to England of such material (other than mosquitoes).

MR. E. PICKWORTH FARROW'S book upon the plant life of East Anglian Heaths was recently reviewed in these columns (NATURE, December 19, 1925, p. 896). Based upon the experience of vegetation study recorded in this book, Mr. Farrow communicated a brief article entitled "The Study of Vegetation" to *Discovery*, which is intended to stimulate and, to some extent, to guide the beginner in this fascinating field of inquiry. In an enlarged form this article has now been reprinted as a pamphlet which is published by Messrs. Blackie and Son, Ltd., on behalf of the Coastal Research Laboratory and Bird Sanctuary at Blakeney Point, Norfolk (price 2*s*.). The price of the pamphlet may seem a little high, but all proceeds from its sale go towards the maintenance of this well-known centre of ecological research, now under the National Trust.

THE Fuel Research Board of the Department of Scientific and Industrial Research has just issued a further pamphlet in the series of the Physical and Chemical Survey of the National Coal Resources. This pamphlet, No. 6, is the fourth dealing in detail with one of the seams of the Lancashire Coalfield, the present one being devoted to the King Seam; sections of the coal in various parts of the coalfield are given as it happens to vary a good deal both in thickness and in quality, the latter point being brought out by analyses of the coal from a number of points in the

coalfield. This pamphlet is on precisely similar lines to those previously published, and gives a mass of valuable information concerning the coal seam under discussion.

MESSRS. J. J. Griffin and Sons and Baird and Tatlock have issued a joint catalogue, No. 50, of scientific apparatus mainly for physics. It is well printed and bound and has 735 pages, 14 of which are devoted to the index. In the section on light, an X-ray spectrograph, neon lamps, and a number of new optical benches are described. Under electricity, several new forms of galvanometers, resistance boxes, selenium cells, and electric furnaces are to be found.

THE latest catalogue (New Series, No. 19) of Messrs. Wheldon and Wesley, Ltd., 2 Arthur Street, W.C.2, deals with upwards of 3000 works relating to astronomy, classified as follows: History, biography, bibliography; origin and development of astronomy from Aristarchus to Sir W. Herschel; periodicals, publications of societies and observatories; elementary works, treatises, dictionaries; spherical and theoretical astronomy; celestial mechanics; practical astronomy; spectroscopy, solar and stellar spectra, photometry, photography; astrophysics, cosmogony; the sun, transits, sunspots; eclipses; Mercury, Venus, minor planets; the earth; the moon; Mars; Jupiter; Saturn, Uranus, Neptune; comets and meteors; stellar astronomy; double and multiple stars; variable stars, red stars and nebulæ, clusters, Milky Way.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—Demonstrators in civil and mechanical engineering in the University of Leeds—The Registrar (July 28). An assistant lecturer in philosophy at the University College of Wales, Aberystwyth—The Secretary (August 3). An assistant in the department of physics of University College, London—The Secretary, University College, Gower Street, W.C.1 (August 7). A lecturer in biology and chemistry at the Municipal Technical College, Swansea—The Director of Education, Education Office, Dynevor Place, Swansea (August 9).. A chemical pathologist and lecturer on chemical pathology (jointly) at St. Bartholomew's Hospital Medical College—The Dean of the College, E.C.1 (August 16). A professor of music at the University College of Wales, Aberystwyth—The Secretary (August 25). A lecturer in moral philosophy in the Queen's University, Belfast—The Secretary (August 31). An assistant master at the Kingston-upon-Thames Technical Institute, to teach engineering workshop practice—The Principal.

Our Astronomical Column.

KOPFF'S PERIODIC COMET.—This short-period comet was discovered by Kopff in 1906, and was detected again after two revolutions in 1919. It passed perihelion last January, when ephemerides were published in the *B.A.A. Handbook* and elsewhere. However, the comet was then badly placed for observation, being nearly behind the sun; it escaped observation for six months after perihelion. Prof. M. Wolf succeeded in photographing it on July 13 at $1^h\ 5{\cdot}2^m$ U.T. in R.A. $1^h\ 17^m\ 12^s$, N. Decl. $18°\ 14'$, the magnitude being 16. The observation indicates Jan. 27·15 as the date of perihelion. The other elements are taken from the *Handbook*:

ω	19°	43′	29″	log q	0·232113
Ω	263	55	10	e	0·51422
i	8	41	30	Period	6·5842y

The comet is probably only observable with large reflectors; the following ephemeris is for 0^h U.T.:

	R.A.	N. Decl.	log r.	log Δ.
July 26.	$1^h\ 27^m\ 48^s$	19° 55′	0·3680	0·3060
Aug. 3.	1 32 24	20 47	0·3761	0·2949
11.	1 35 33	21 31	0·3839	0·2828
19.	1 36 48	3	0·3917	0·2715

THE CONSTITUTION OF THE INTERIOR OF THE EARTH.—Dr. H. Jeffreys read a paper on this subject at the June meeting of the Royal Astronomical Society which is printed in vol. 1, No. 7, of the Geophysical Supplement of the *Monthly Notices, R.A.S.* It has hitherto been supposed that the rigidity near the earth's centre is very great, but since it was discovered that secondary seismic waves are (apparently) not transmitted through this region, Dr. Jeffreys reinvestigated the data for rigidity in the interior, including that based on the tides, and finds that they are quite consistent with the interior being composed of liquid iron, possibly with an admixture of nickel. The depth of the outer boundary of this liquid core is given as 2900 km. or 0·455 of the radius, this being the surface of discontinuity of seismic waves found by Gutenberg. Though mainly geophysical, the paper has also an astronomical bearing.

LARGE SOLAR PROMINENCE.—The recent appearance of a very large prominence has been reported by Mr. Newbegin observing with his solar spectroscope at Sutton. On July 16 at $10^h\ 25^m$, it extended 40° around the sun's west limb—from position angle 276° to 316°—and its height was then 85 seconds of arc. Probably it is the largest prominence observed as yet during the present cycle. Its character was of 'massive' formation and quiescent in type. An amount of fine detail is indicated by Mr. Newbegin's sketch, the prominence appearing to be composed of a number of tree-like structures rising at more or less equal distances from the chromosphere and connected together by branching filaments.

As a class, the large massive prominences last for some time—frequently for several weeks—and although usually found within the sunspot zones they are rarely, if ever, seen above a spot. In the present instance there was no spot in the vicinity, but there were faint patches of faculæ which were the remains of the extensive area connected with the great spot of December and January last. Indeed, the position of the prominence, at least for a portion of it, is almost identical with that of this spot. The mean position of the spot during its two transits in December and January was longitude 32°, latitude 22° N. Allowing for the average polar retardation at latitude 22°, the longitude of the place originally occupied by the spot was 0° on July 16, while the longitude of the sun's western limb on the same day at the time of Mr. Newbegin's observation was 2°.

Spectroheliograms showing disc markings and limb phenomena have doubtless been secured at several observatories equipped with spectroheliographs and should give additional information of great value as to the life-history of this large prominence, which is evidence of a recrudescence of activity in the chromosphere above an extinct sunspot. It may be added that no unusual magnetic disturbance has recently been recorded in this connexion.

Research Items.

EFFECTS OF MENTAL WORK.—A paper of great interest on the changes which take place in the metabolism of the body during severe mental work has been published by Prof. V. Suk of the Masaryk University, Brno, Czechoslovakia (*Bull. internat. de l'Acad. des Sc. de Bohême*, Nov. 20, 1925). Prof. Suk took the following three groups of students: Group 1—29 men undergoing physical training in a teachers' college; group 2—31 members of the highest class in a *gymnasium* working for final examinations; group 3—31 members of another class also working for examinations. He kept these three groups under observation for three months, keeping a record of the amount of hæmoglobin and of sugar in their blood. There was a slight increase on the percentage of hæmoglobin in those undergoing physical training while that in the brain-workers remained stationary. On the other hand, while the blood-sugar remained stationary in those who exercised their bodies, there was a fall of 36-38 per cent. in the sugar content of the blood in the brain-workers. Severe and prolonged mental toil, therefore, does interfere with the carbohydrate metabolism of the body. The exact mechanism by which the nervous system produces this change is not apparent, but it may be through an effect produced in the functions of the liver. It is well known that brain-workers are particularly liable to colds and other infections, and Prof. Suk suspects that this liability may arise from the reduction of their blood-sugar.

THE CHANCELADE SKULL.—In *Annals of Eugenics*, vol. 1, Parts 3 and 4, Mr. G. M. Morant compares, by means of modern statistical methods, the craniometrical features of the skull found in 1888 by Féaux and Hardy near Raymonden, Chancelade, with those of Fürst and Hansen's series of Greenland Eskimos. He concludes, in agreement with the suggestion of Testut, and contrary to Keith's recent verdict (*Man*, 1924), that the Magdalenian skull is not more removed from the mean type of the modern inhabitants of Greenland than many individuals picked at random from that population are likely to be. In accordance with the view that the Chancelade individual was closer to the Eskimo than to the modern English, he sees justification for assuming that, in the Magdalenian period, a race of hunters existed in southern Europe, which migrated northwards following the reindeer, or was pushed to the fringe by other and invading races. Excellent photographs, taken with a telephoto-lens to reduce distortion, accompany the study.

POTTERY FROM CHANCAY, PERU.—A further study of the Uhle Collections of Peruvian pottery in the University Museum appears as vol. 21, No. 7, of the *University of California Publications in American Archæology and Ethnology*. Mr. A. L. Kroeber now describes the pottery from Chancay which was obtained by Dr. Uhle in graves on five sites described in his field notes, part of which form an appendix to the present publication. Five successive styles are represented: black-on-white, a style known as that of Chancay and the latest in date; three-colour geometric, epigonal (three and four colour), white-on-red, and the interlocking style. White-on-red is a hitherto undescribed style which is definitely Central Peruvian. The interlocking type, of which the most common design has the typical outline of complementary animal heads with worm-like bodies having serrated edges, is undoubtedly textile in origin. Certain vessels present affinities with the Proto-Nasca of Ica, and, further, round lumps of adobe characteristic of Proto-Nasca construction were also found with the Chancay burials. Dr. Uhle has demonstrated the relation of Ica in the north and Truxillo in the south. Notwithstanding the wide geographical separation of the two styles, Chancay, lying half-way between the two, appears to bridge the gap by a civilisation of the same general character, and suggests a cultural stage all over Peru at a remote epoch antedating Tiahuanaco. The importance, undoubtedly religious, of this design was indicated by the discovery of a painted wall belonging to a small terrace building on an artificial base. The wall was 23 m. long and 1·6 m. high at its best-preserved part, and was painted in four colours with outlines of the textile design.

THE FOX INDIANS.—The fortieth annual report of the Bureau of American Ethnology (1918–19), which has just been issued, contains, in addition to the report of the chief of the Bureau, five accompanying papers by Dr. Truman Michelson based upon material gathered fourteen years ago and supplemented by later information dealing with the Fox Indians of Iowa. Each paper is a Fox text written out in the current syllabary by one of the Indians and afterwards phonetically restored, accompanied by an English translation and ethnological and linguistic notes by the author. The first paper deals with the mythical origin of the White Buffalo dance, and contains, in addition to the information about Fox ritual, some interesting data bearing upon changes in custom and the social and religious outlook of the Indians. The reverent observance of religious rites still to be found among the older men is no longer characteristic of younger generations, who attend the dance purely for social purposes and to get something to eat. A note on mortuary customs and beliefs is important for its detail and for the light it throws on observances in connexion with behaviour after death of a husband or wife and remarriage. Of the remaining three papers, two deal with Fox religious societies, and the third, an autobiography of a Fox woman, is unique. It begins with her earliest recollections, and from her eighth year gives particulars of her introduction to the various household duties which fall upon the woman in the Indian family. At nine years she helped her mother in the planting; at ten in washing clothes and cooking, and in cutting and gathering wood; at eleven she learned to make bags, and so on. One of the most interesting features of the story is the importance of the mother's brother, which becomes especially marked after marriage, when the father ceases to function in relation to his daughter and his place is more than taken by the uncle. For example, the uncle advises his niece as to her behaviour after divorce, and when her husband dies instructs her in the mourning ceremonies and the observances which secure release from the death ceremonies. Apparently this function of the maternal uncle has nothing to do with matrilinear descent, and cannot be regarded as a survival of that system, though the Foxes are now patrilineal.

THE ALIMENTARY CANAL OF SCORPIONS.—In the current issue of the *Quarterly Journal of Microscopical Science* is a detailed account by Prof. E. N. Pavlovsky and Prof. E. J. Zarin of their studies on the structure and functions of the various parts of the alimentary canal of scorpions. The authors have not been able to investigate the physiological properties of the maxillary glands, which it is believed may produce a proteolytic ferment. The food—the juices and muscles of arthropods and of earthworms—passes

into the stomach of the scorpion, where it is acted upon by pepsin, trypsin, chymosin, and lipase. The mid-gut of scorpions is of insignificant volume as compared with the cavities of the liver tubules, and it is evident that the latter are of the greatest importance. They contain two kinds of cells, secretory cells, producing ferments which act on proteins, fats, and carbohydrates, and absorptive cells. The authors suggest that the liver also plays a part in excretion, the presence of brown granules in its cells being cited as evidence. The intestine appears to play little or no part in the digestive processes.

LUMINOUS FISHES AND CEPHALOPODS OF THE MEDITERRANEAN.—Number 9, vol. 2 (Biology), A. 12, of the report of the Danish Oceanographical Expedition, 1908–10, to the Mediterranean and adjacent seas includes an extremely interesting account of the Mediterranean Sternoptychidæ by P. Jespersen and Å. Vedel Tåning (Copenhagen: Andr. Fred. Høst and Søn, 1926. 35s.). In their study of these peculiar luminous fishes, much light is thrown on their breeding, life-histories, and migrations. Many of these fishes tend to move to a greater depth with increasing age, the adults often occurring naturally at a depth of more than 1000 metres, whereas the post larvæ are found much higher up. The photophores in this group are important as a means of classification, but in many of the genera these do not appear until late in post-larval life or after metamorphosis, and there is often an enormous alteration in general appearance and also a great reduction in length, as, for example, in *Ichthyococcus ovatus*. Dr. Degner's important monograph (C. 1), which is also included in No. 9, vol. 2, of this report, on the cephalopods deals also with a group which in many forms is luminous, but in this case comparatively few are from great depths. The majority occurred between the surface and a depth of 65 metres, and mainly belonged to the Decapoda. A single specimen of an adult Argonauta was obtained in the Mediterranean and one of Spirula just outside, close to Gibraltar. Many young forms of various species were taken and a few new species are described, including *Mastigoteuthis Schmidti* and *Desmoteuthis Thori*, both from waters of 2700 metres depth.

AMPHIPODS AND DIATOMS FROM THE DANISH OCEANOGRAPHICAL EXPEDITION.—In Number 9, vol. 2 (Biology), D. 5, of the report of the Danish Oceanographical Expedition, 1908-10, to the Mediterranean and adjacent seas (Copenhagen: Andr. Fred Høst and Søn, 1926. 35s.), Dr. K. Stephensen finishes his account of the Hyperiidea-Amphipoda, of which Parts 1 and 2 have already appeared. A large portion of the present work is taken up by the valuable synopsis of the Hyperiidea in which the Mediterranean species, eighty in all, are fully discussed. The author finds that there do not seem to be any species endemic to the Mediterranean, nearly all being found also in the Atlantic, and there seem to be scarcely any differences between specimens from the two areas. The Hyperiidea are almost exclusively oceanic, and many are found over great depths, some never rising above a 300-metre level; but of these deep-water forms few enter the Mediterranean. The species found there belong almost exclusively to the surface layers. Prof. Pavillard, in the same volume (J. 4), gives an interesting account of the planktonic diatoms which in these regions are really fairly well known, and his investigations show few new species but much new matter as regards distribution. The absence or great rarity in the Mediterranean of certain species common and well known in the English Channel and outside is striking. Thus *Hyalodiscus stelliger* apparently does not occur, *Paralia sulcata* is very rare, and *Thalassiosira gravida* is replaced by *T. rotula*. The summaries of the larger genera such as Chætoceros, Rhizosolenia, and Coscinodiscus are instructive and helpful, and as an up-to-date guide to pelagic diatoms the whole work is extremely valuable.

MICRO-ORGANISMS IN INDUSTRY.—In his presidential address to the Royal Microscopical Society, Mr. A. C. Chapman gave an account of some of the Fungi imperfecti—torula, mycoderma, ooidia—and their activities (*Journ. R. Micr. Soc.*, vol. 46, Part 1). He referred to a yeast-like organism, isolated by Prof. Lindner of Berlin in 1916 from the sap which had exuded from a birch tree, which was able to grow freely on the surface of carbohydrate solutions containing ammonium salts and to form a thick greasy film This film when separated and dried was found to contain 18 per cent. of fat, 31 per cent. of crude protein, and 43 per cent. of carbohydrates, so that, given a cheap source of carbohydrate and ammonium salts, it was evident a food product rich in fat and protein could be produced in large quantity. Mr. Chapman isolated a similar organism in 1917, and reports that the product of its activity contained about 50 per cent. of crude protein and up to 10 per cent. of fat, and that when pressed it formed cakes having the odour and flavour of cream cheese. He points out that if an efficient biochemical process were discovered for the conversion of cellulose into sugar, the production of a synthetic food product on a large scale would become practicable perhaps even under peace conditions. He quoted a sentence from a lecture which Hayduck delivered in Berlin in 1916—"when we can convert our evening papers into sugar so rapidly that we are able the following morning to eat the albumen prepared therefrom, then indeed we shall have solved one of the greatest problems of the century." Mr Chapman advocates the founding of a National Institute of Industrial Microbiology for research on micro-organisms which play an important part in industry, for the training of teachers of microbiology, and for maintaining a collection of pure cultures of micro-organisms for industrial purposes.

AUSTRALIAN RIVER BASINS.—A map of Australia, showing the extent of the drainage areas of the various rivers, has been published by the Bureau of Meteorology of the Commonwealth of Australia. The positions of river gauges and flood report stations are also shown. The map should prove useful in connexion with the flood warning service of the Bureau. In times of heavy rainfall, it will facilitate the issue and distribution of flood warnings to the districts concerned. The map is on the scale of 200 miles to an inch and a half.

THE CLIMATE OF HELWAN.—A discussion on the above by Mr. L. J. Sutton, Director of the Egyptian Meteorological Service, has been issued by the Ministry of Public Works, Egypt, as Physical Department Paper No. 20 (Government Publication Office, Cairo, price P.T. 10). The present report deals with the observations of the years 1906–20, and fifteen years are said to be probably sufficient in a climate like that of Helwan to give a fair representation of a true normal, except perhaps for rainfall. The scheme for the report was commenced by Mr. Knox-Shaw, but, owing to his appointment as Radcliffe Observer at Oxford, the work of preparing the report was handed to Mr. Sutton. The climate of Helwan is essentially of the Saharan desert type. There is a short winter, December to February, when the nights are cold, averaging 9° C., and the days comparatively warm, averaging about 20° C. The temperature never falls to the freezing-point, the lowest ever

recorded being 1·6° C. Nearly 8 hours of sunshine are enjoyed each day, and normally there are only 3 days of rain in each of the winter months, but sometimes thunderstorms occur with heavy rain. Summer commences in June and lasts until the end of September; from June to August there are more than twelve hours of sunshine a day, the temperature reaches 35° C. on the average during the daytime and falls to about 21° C. at night. In the early part of summer, temperatures of 40° C. are not uncommon, and on two occasions a temperature of 46° C. (115° F.) has been recorded. The summer is rainless, and there is scarcely any rain from May to October. Tables and diagrams with detailed accounts are given of all the meteorological elements. The work adds much to our knowledge of weather conditions in this part of the globe.

WEATHER AND AGRICULTURE.—Responsible United States officials engaged in the Weather Bureau, the Bureau of Agricultural Economics, and the Forest Service have co-operated in producing a discussion, No. 918, published by the United States Department of Agriculture (Washington: Government Printing Office, price 20 cents). It is asserted that so early as 3000 years B.C. man was a tiller of the soil and gathered a harvest. Since then the history of agriculture and the weather has been contemporaneous with that of civilisation itself. The development of agricultural education such as the establishment of agricultural colleges and experimental stations is dealt with. The influence of the weather and especially the control of weather by cyclones and anticyclones is referred to and the adjustment of agriculture to climate, soil condition and topography. Maps are given showing the distribution of rainfall over the globe, and the natural vegetation, and also air isotherms over the world for January and July. Referring to the rapidly increased population in recent times, the unoccupied arable land of the world has become gradually occupied until to-day very little remains in regions with healthful climates. It is stated that the United States, with only about 5 per cent. of the world's population, produces one-seventh of the world's cattle, one-fifth of its wheat, and three-fourths of its corn. Rainfall and crop growth is gone into with considerable detail, also the temperature influence on crop distribution. It is asserted that where climate and other conditions permit of mixed farming, the weather hazard is very much reduced. Many matters such as weather and the railroads and details intimately associated with salving the crops are of much interest.

METEOROLOGY AND GEOPHYSICS IN POLAND.—In Communications Nos. 1-18, Institut de Geophysique et de Meteorologie de l'Université de Lwów, Prof. H. Arctowski and eight collaborators publish a series of papers on meteorological, astronomical, and geophysical subjects. Eight papers contain discussions of temperature variations observed during the years 1910-1919 at Arequipa and at a number of widely separated stations. These temperature variations are employed to show the distribution and movement of "thermo-pleions" (areas of positive departure of temperature from the normal) and "antipleions" (areas of negative departure) in Egypt, Hawaiian Islands, India (the Deccan), New Zealand, Peru, Philippine Islands, Russia, and Scandinavia. The agreement between the Arequipa or standard type of thermo-pleionian fluctuation and that prevailing in the Deccan is found to be particularly striking during the ten years of observation. Four other papers deal with pyrheliometer observations. During 1924 a number of these observations were made by three different methods at Pozyzewska (altitude 1406 metres) in the eastern Carpathians for the purpose of finding a suitable site for a solar observatory. The remaining contributions relate to (1) The dissimilarity of the variation of the frequency of sunspots observed north and south of the sun's equator, and the desirability of considering sunspot statistics for each hemisphere separately; (2) the anomalies in the measurement of rainfall and the exposure of rain-gauges; (3) the determination of the "geothermic" degree from observation of the temperature gradient existing in certain petroleum wells in Poland; and (4) the occurrence of potassium salts in Poland. The above series of papers have been published in the *Kosmos*, vols. 46-50, 1922-1925.

MAGNETIC VARIATION IN NORTH AFRICA.—The secular magnetic variations at Tunis, Carthage and Malta are considered by Dr. L. Palazzo in the *Memorie della Pont. Accademia delle Scienze Nuovi Lincei*, vol. 8, 1925. Dr. Palazzo himself made observations of all three magnetic elements at Tunis and Malta in 1890, and has recently repeated the observations. In 1890 he also measured the horizontal intensity at Carthage. In this memoir he summarises other observations available for the three stations, and constructs graphs showing the secular variation of declination, dip and horizontal intensity; for Tunis the graphs extend from 1875 to 1925, in which time the declination has decreased by about 5° to its present value of about 7° 20′ E. The Carthage declination and dip graphs extend from 1820 to 1905, and are in general agreement, as regards secular variation, over the period in common with those for Tunis, as would be expected from the proximity of the stations. The Malta data extend from about 1820 to 1925, and show a decrease in E. declination from 17° 20′ to 5° 40′.

VELOCITY OF DETONATION FOR EXPLOSIVES.—The explosives in general use in fiery and dusty mines belong to the class of detonating explosives. It is known that the ignition of inflammable gases in the neighbourhood of the borehole depends in large measure on the velocity of detonation. It is therefore of great importance to find a method of determining this velocity for the practical explosives used in mines. To determine this velocity, very small intervals of time of the order of a millionth of a second have to be measured. A method suitable for doing this is described by E. Jones in the Safety in Mines Research Board, Paper No. 22 (London: H.M. Stationery Office, 1926. Price 9*d*. net). The method is an electrical one. It depends on the partial discharge of a condenser through a known non-inductive resistance. The time of the discharge is the time taken by the detonation wave to travel between two points at which the circuits are broken. The times computed were tested with mechanical arrangements which gave time intervals of the order 10^{-4} sec. to 10^{-6} sec. The results were concordant for long fuses, but unsatisfactory when the trinitrotoluol fuse was only about 10 cm. long. The discrepancies in this case were traced to electrical phenomena due to detonation, and were overcome by removing the break-points of the circuit to a distance from the detonating explosive. Consistent results were now obtained, although the fuse length was reduced to 2 cm. The difference between the results and that given by the Mettegang method for metre lengths of the explosive was rather less than 3 per cent. The latter method, however, only gives the average velocity over the metre. The agreement consequently is satisfactory. Further researches are in progress.

Oxford Meeting of the British Association.

PROVISIONAL PROGRAMMES OF SECTIONS

WE print below short accounts of the proceedings of the various sections of the British Association at the Oxford meeting to be held on August 4-11. For these particulars we are indebted to the recorders of sections. The statements are brief, but it is clear that interesting and stimulating sessions have been arranged which should do much to make the Oxford meeting memorable in the history of the Association.

SECTION A (MATHEMATICS AND PHYSICS)

The coming meetings of Section A (Mathematics and Physics) are likely to be filled with interest. Apart from the attractions of Oxford itself with its own important schools in these subjects, there are two other contributing factors. First, the list of foreign guests is a particularly interesting one, the visitors including Bohr, Born, Carathéodory, Franck, Runge, Siegbahn, Wien and Zeeman, in addition to well-known representatives of the Dominions overseas. Secondly, a full programme has been arranged for a subsection in mathematics, meeting for three mornings. This should attract many mathematicians who may have refrained from attending previously owing to the minor part that this subject has played in the programme of the Section in recent years.

In physics, in addition to full accounts of work being carried out in the laboratories of Prof. Townsend and Prof. Lindemann, papers will be read by Sir Ernest Rutherford, Sir William Bragg, Prof. W. L. Bragg, and others. On Monday, August 9, Prof. A. Fowler's presidential address will be followed by a discussion, in which most of the foreign guests are expected to take part. A joint discussion with Section B (Chemistry) on the mechanism of homogeneous chemical reactions should enable many physicists to learn something about a subject in which few of them have specialised.

In mathematics, in addition to a full morning on integration and trigonometrical series, special lectures from Dr. T. M. Cherry, Mr. F. P. Ramsay, Mr. M. H. A. Newman and Mr. T. W. Chaundy have been arranged, and contributions are expected from Sir George Greenhill and Prof. E. A. Milne. Lastly, a paper by Mr. Stratton on the recent eclipse observations, and by Prof. Turner on the coming total eclipse in England, should make a wide appeal throughout the Section.

SECTION B (CHEMISTRY).

Prof. J. F. Thorpe will deliver the presidential address to Section B (Chemistry) at 10 A.M. on Thursday, August 4, and will take as his subject "The Scope of Organic Chemistry." Two discussions have been arranged—one (a joint discussion with Section A) on the mechanism of homogeneous chemical reactions and the second one on tautomerism. Prof. W. N. Haworth is to submit a paper on modern views on the structure of the disaccharides, and Mr. J. J. Manley is to describe the work he has conducted on the union of mercury and helium. Of the foreign visitors, Prof. J. Backer is reading a paper on separation and racemisation of simple optically active compounds, and Prof. H. ter Meulen is to describe the uses of hydrogenation in organic analysis. A novel feature of the work of the section will be a paper by Mr. A. Chaston Chapman and Dr. H. J. Plenderleith on an examination of King Tutankh-Amen's cosmetic.

SECTION C (GEOLOGY).

The communications promised for Section C have been so numerous that the time available for presentation and discussion may prove inadequate. Although the meetings of the Section have been extended beyond the normal number, selection of papers has been necessary; yet the programme as at present arranged covers a very wide range of interest, and, so far as possible, kindred studies have been grouped. It is invidious to pick out any papers for special mention, but, to take a conventional subdivision of the subject-matter into mineralogy and petrology, palæontology and physical and stratigraphical geology, the following notes may suffice to convey some idea of the scope of the programme.

The atomic structure of silicate minerals has proved difficult up to the present, but a paper on certain of these minerals is promised, while communications on the textures and structures of igneous rocks will also be received. Sedimentary petrology is also represented. In the realm of palæontology the faunas and classification of the faunas of certain epochs in the past will be considered, notably those of Cambrian and Silurian times; the fauna of more recent deposits, local to Oxford, will be represented by an exhibit which may be consulted during the meeting. Physical and stratigraphical geology will naturally figure largely, and here interests range in time from pre-Cambrian to recent, and in space from England to the farthest confines of the British Empire.

Two important discussions will be held: one on problems connected with the Thames gravels and their fossil contents, and the other in conjunction with Sections D (Zoology) and K (Botany) on the "Conception of a Species." In all branches of natural science the definition of units is necessary, and a biological unit is as fundamental as a unit of length or of temperature. Unfortunately the species, as a unit, has not proved capable of rigid definition, and, from time to time, it is obligatory to take stock of the position. The discussion therefore should be of value in stating the present ideas on this fundamental biological concept.

In the interests of those who are beginning research work and desire some knowledge of technique, a series of short descriptions of certain research methods will be given by workers who have taken special interest in the development of such processes. Demonstrations have also been arranged in illustration.

A most important part of the work of the section centres round the excursions. The local secretaries have so arranged their work that this part of the programme has been in the hands of Mr. C. J. Bayzand, who has drafted an excellent series of half-day and whole-day visits to the neighbourhood. Ill-health may prevent him from being present on these trips, but it is hoped that he may be recovered in time to reap the reward of his sowing. On present showing, then, the Oxford meeting, so far as Section C is concerned, promises to be an excellent one from every point of view.

SECTION E (GEOGRAPHY).

Much attention has been directed of late to economic and social problems associated with the awakening of Negro Africa. Their complexity defies unanimity on methods of administration and development. The president of the Section—the Hon. W. Ormsby Gore,

Under Secretary for the Colonies—following his recent investigations in East and West Africa, will speak on "The Economic Development of Africa and its Effect on the Native Population." This will be followed on the afternoon of Thursday, August 5, by an important joint discussion with Section H (Anthropology) on "The Effect on African Native Races of Contacts with European Civilisation." Among those who will take part in the discussion may be mentioned the Rev. Edwin Smith, Sir Frederick Lugard, Capt. G. Pitt-Rivers, Prof. J. W. Gregory, Sir James Currie and the Hon. Hugh Wyndham.

In Britain, of recent years, one of the most striking applications of geographical study has been the attempt consciously to adjust conditions of life and industry to locality, especially in urban areas. Town planning and regional surveys have in a measure reacted on the character of some of the geographical research in the universities. Two papers, one on London and the other on Manchester, illustrate what is being done in the several university schools of geography, and will form the basis of a general discussion on "Regional Work in Geography."

Several papers present historical aspects of geographical science: Elizabethan theodolites and astrolabes, by Dr. R. T. Gunther; the 'Pantometria' of Leonard Digges, by Mr. A R. Hinks; the British Isles in the nautical charts of the fourteenth and fifteenth centuries, by Mr. M. C Andrews; roads on English and French maps at the end of the seventeenth century, by Sir George Fordham. The numerous implications which the geographical study of a region involves is well represented by such contributions as Dr. D. G. Hogarth's on "Our Near Eastern Borders," Prof. Lyde's on modern markets for Canadian wheat, and Mr. Dunlop's comparison of Queensland and Jamaica.

Geographical excursions have been arranged to Brill, the Cotswolds, the central Chilterns and the Goring Gap.

Section F (Economics).

In his presidential address to Section F (Economics), Sir Josiah C. Stamp will deal with "Inheritance as an Economic Factor"; it is expected that Prof. Rignano (Italy), Dr. Hugh Dalton, M P, Prof. Edwin Cannan and others will take part in the discussion.

A distinctive point of view upon "Collective Bargaining" will be presented in a paper by Sir Lynden Macassey, in which he will argue that effective collective bargaining is the basis of industrial stability and that recent events have shown the absence of this condition in Great Britain. Mr. Flux, of the Board of Trade, will deal with the markets of the chief British export industrial centres and will use material which has not previously been available for this purpose.

A discussion of peculiar present-day importance will take place upon currency problems, and it will be opened by Prof. Gregory in a paper dealing with the gold standard.

In addition to such topics of outstanding interest as those mentioned above, the Section is to take part in a discussion on a "Survey of the Limits of Agricultural Expansion," which will form the subject of Sir Daniel Hall's presidential address to Section M (Agriculture)

Section G (Engineering).

The programme of Section G includes discussions on subjects of very varied interest. The president, Sir John Snell, chairman of the Electricity Commission, in his address will deal with the important subject of electric supply, its recent and probable future development. Following the address Mr. Kennedy will read a paper on the distribution of electric energy, and Mr. Borlase Matthews will discuss the use of electricity in agriculture; some phenomena of conduction will be discussed by Prof. Cramp. Refrigeration, particularly in relation to food preservation and transport, is a subject of scientific and practical interest, and two papers by Dr. Ezer Griffiths and Prof. C. F. Jenkin are to be followed by a discussion in which Sir William Hardy and Sir Richard Glazebrook will take part. The papers will describe small plants that have recently been developed and experiments carried out in the laboratory and on four ships. In connexion with this discussion, a number of small plants will be working in the University Engineering Laboratories.

Recent developments in aircraft are to be discussed. Mr. Wimperis will deal with the 'rotating wing' and describe experiments and the attempts that have been made to use the device for sustentation purposes; the possibilities of its use will be discussed. The researches that have been carried out in connexion with the development of a compression ignition engine for aircraft and burning heavy oils will be described by Mr. H. D. Pye. The problem of producing a fuel jet which penetrates the compressed gas sufficiently to give adequate mixing of air and fuel, and at the same time to obtain sufficient pulverisation and combustion in the short time available, will, *inter alia*, be dealt with. It has been found possible to burn 70 per cent of the oxygen in the cylinder, but to get perfect mixing at high speeds is extremely difficult. The possibility of eliminating all complications and danger incidental to electric ignition makes it worth while to attempt to develop a compression ignition engine sufficiently light for aircraft purposes. The use of light alloys in aircraft is becoming increasingly important, and the paper by Mr. Bengough and Mr. Sutton will describe the anodic oxidation process which has been successfully developed to render these alloys immune from surface corrosion.

Experiments on materials subject to complex stress conditions will be discussed by Prof. F. C. Lea and Mr. S. Timoshenko.

The microscopic and macrographic methods of detecting the sulphur bacterium *Beggiatoa Alba*, and investigations in which its presence indicates sewage pollution, will be described by Prof. Ellis. The cause of the blackening of the river sands below water level in the Clyde Estuary has been investigated, and it has been shown that this is not due to sewage pollution but to the formation of ferrous sulphide by a reaction between the ferruginous constituents of the sand and the hydrogen sulphide liberated by bacteria which consume the animal and vegetable remains on the shore. A paper by Mr. Edgar Morton on the "Composition and Texture of Sandstone and Limestone in relation to Strength and Durability" should prove of interest to geologists, engineers, architects and builders Papers dealing with the distribution of pressure in turbines and the influence of voltage harmonics on power factor correction are to be given.

Section H (Anthropology).

In Section H (Anthropology) one of the most important features of the programme will be the exhibition of the human skull found in association with Mousterian implements by Miss D. A. E. Garrod near the Devil's Tower, Gibraltar. In view of the conditions of its discovery and its possible relation to the skull of Neanderthal type found at Gibraltar in the middle of the last century, it should give rise to an important discussion. Miss Garrod's discovery will give added interest to Sir W. Boyd Dawkins'

paper on the range of the Neanderthal race on the Pleistocene continent.

The Section will engage in two joint discussions with other sections. The first, with Section E, on the effect on African races of contact with European civilisation, arises directly out of Mr. Ormsby Gore's presidential address to Section E, and will be opened for Section H by the Rev. E. Smith, who will be followed by Sir Frederick Lugard, should his engagements permit. The second joint discussion, with Section D (Zoology) and Section J (Physiology), on mental and physical aspects of heredity, will be opened by Dr. C. S. Myers, to be followed by Profs. Ruggles Gates and Julian Huxley. Sir William Ridgeway will open a sectional discussion on "The Origin of the Scot."

Among a large number of communications making up the remainder of the programme mention can be made of a few only. Sir Arthur Evans on "The Shaft-Graves of Mycenæ and their Contents in relation to the Beehive Tombs" is likely to prove provocative of animated discussion; Mrs. Zelia Nuttall, the distinguished American archæologist, in dealing with the ancient calendar systems of America, will give the Section what is virtually a summary of the results of her life's work. The excavations of the British School at Athens during the past three seasons will be described by Mr. A. M. Woodward, the Director, and Mr. W. A. Heurtley, the latter dealing with his own investigations in Macedonia. Recent excavations in Mesopotamia will be covered by Mr. C. L. Woolley on his recent work at Ur, and Prof. Langdon on work at Kish, skulls from the latter site being described by Mr. L. H. D. Buxton. In Egyptian archæology Miss Gardiner and Miss Caton-Thompson will describe their recent work on the geology and early archæology of the Fayum, and Sir Flinders Petrie will put forward for discussion his views on the prehistoric relations of Egypt and the Caucasus. An important paper by Mr. Gordon Childe will deal with the Terramare and the Hungarian Bronze Age, in which he will carry further his previously published work on the prehistoric archæology of Central Europe.

An interesting series of papers dealing with physical anthropology must be passed over, but in conclusion mention must be made of Miss Alford's communication on 'the ritual dance,' in which she discusses the ritualistic origin of a number of English folk-dances and cites continental parallels. The paper will be illustrated by dances performed by members of the English Folk-Dance Society.

Section I (Physiology).

By an unfortunate chance the British Association meetings this year fall at the same time as the (triennial) meetings of the International Congress of Physiology, which will be held at Stockholm on August 3-6. Although the Section may, in consequence, lack a certain number of British and of foreign workers, the sectional programme is quite a full one. The subject of the presidential address is "Function and Design": to this question Prof. Leathes is bringing a fresh outlook, notably from recent work on molecular structure and orientation, with a special consideration of the arrangements at the limiting surfaces and membranes of the organism.

As was suggested in the columns of NATURE of May 29, p. 747, the lecture by Dr. J. S. Haldane on "Acclimatisation to High Altitudes" is of particular interest, in that a reply to Prof. Barcroft's recent publications may confidently be expected, and a consideration of the physiological observations and problems connected with the climbs on Mount Everest. In the joint discussion with Section D (Zoology) on the value of tissue-culture in biology, members will have the first opportunity in England of hearing from Prof. Ch. Champy, of the Sorbonne, an account of his technique and the results he has obtained in this work. The discussion will be opened by Dr. H. M. Carleton, who is in charge of the Department of Histology at Oxford.

A symposium on the 'machinery' whereby a posture is set up or maintained, will allow an exchange of observations and opinions between clinicians and laboratory workers, who have a common interest in this problem, though their paths of approach may be entirely different. Of wide interest, again, is Sir J. C. Bose's lecture on "The Pulse-Beat of Plant and of Animal," while among the more specialised papers are contributions on colour-vision, on biochemistry, and on visceral sensation.

Section J (Psychology).

Applied psychology figures prominently in the programme of Section J (Psychology); thus the presidential address by Dr. J. Drever is entitled "Psychological Aspects of our Penal System." A whole session is given to such industrial questions as accidents in industry, restriction of output, and the judgment of value of individual advertisements. There is also a lecture on recent progress in vocational selection. These papers will give an account of some of the activities of the National Institute of Industrial Psychology.

Medical psychology is represented by three papers, namely, personality and value, a method of self-analysis, and heredity and environment in the production of morbid mental reactions. That psychologists are paying attention to heredity is shown by their participating with Sections D and H in a joint discussion on heredity in its physical and mental aspects.

It is gratifying to note that all past presidents of the Section are contributing papers: Prof. C. Lloyd Morgan, "Individual and Person"; Dr. C. S. Myers, "Heredity in its Physical and Mental Aspects"; Prof. Cyril Burt, "Estimations of Temperament and Character"; Prof. W. McDougall, "An Experiment supporting the Lamarckian Hypothesis" and "Intelligence in Rats". Prof. C. Spearman, "The Origin of Error."

Of the more academic papers mention should be made of one by Prof. Rignano of Milan on "La psychologie dans ses Rapports avec la Philosophie et avec la Science," one by Prof. Michotte of Louvain on observation and analysis of mental facts, one by Dr. Aveling on the psychogalvanic phenomenon, and one by Dr. Banister on the localisation of sound. A paper by Dr. Maxwell Garnett on the psychology of patriotism should prove of wide interest; also one by Mr. F. C. Bartlett, Director of the Cambridge Psychological Laboratory, on the social psychology of leadership.

Section K (Botany).

Owing to the lamentable death of Mr. W. Bateson, Section K (Botany) will meet at Oxford under the presidency of Prof. F. O. Bower. The Section will participate in a discussion on "The Conception of a Species" with the Sections of Geology and Zoology. Within the Section there will be a discussion on sex-determination in plants, which will be opened by Dame Helen Gwynne-Vaughan and contributed to by Dr. Heslop Harrison, Prof. H. Kniep, and Miss Cayley. Prof. J. H. Priestley will initiate another sectional discussion on the scientific principles underlying vegetative propagation, a subject on which a good

deal of light has been thrown recently. The popular lecture will be given by Sir Frederick Keeble on "The Nervous System of Plants."

A large number of papers representative of different branches of botany have been included in the programme, the subject of genetics being particularly well represented this year A notable feature of the Oxford meeting will be the attendance of a larger number of distinguished foreign botanists than has been the case in recent years. All of them are contributing actively to the programme As in the last few years, there will be a Sub-section of Forestry, which will be linked with Section K. The Sub-section also has a very full programme, and will be presided over by Lord Clinton.

SECTION L (EDUCATION).

Section L (Education), under the presidency of Sir Thomas Holland, opens its session at Oxford on Thursday, August 5, with several papers dealing with the place of history of science in education Dr. Charles Singer and Prof. Cecil H. Desch will discuss the subject from the point of view of its value as a humanising element in the teaching of science at university or school. Dr. Gunther will demonstrate the educational value of the Lewis Evans' Collection of historic scientific instruments at the Old Ashmolean Building.

Later in the meeting the more recent advances in educational science will be discussed: the development in the general conception and scope of education during the last twenty-five years by Prof. T P. Nunn; the education of children under eleven years of age by Miss Margaret Drummond; developments in methods of teaching by Dr. M. W. Keatinge; the organisation of education by Prof. Strong; and educational psychology by Prof. C. Burt. The Section will be invited to discuss scholarships—methods of award and their effect on the present system of education—by Mr. William Hamilton Fyfe. Important results of a recent investigation into the claims of the kinema and of radio to be potent agencies in modern education will be brought before the Section by Dr. C W Kimmins, Mr. G. T. Hawkin, and Dr. J C Stobart The public school system is to be reviewed by Mr Ronald Gurner, Mr. W. W. Vaughan, Mr. M. L Jacks, Dr. Crichton Miller, and Mr. F. J. R. Hendy Its relation to national life, its psychological interpretation, its value as a training in community life, together with a critical appreciation of its economic position, are some of the features of the papers to be read.

On Thursday, August 5, a joint session of Section L (Education) and M (Agriculture) will be held in the hall of the Union Society to discuss the educational training of boys and girls in secondary schools for life overseas. Various aspects of this question will be dealt with by Sir A Daniel Hall, Hon. W. Ormsby-Gore, Sir Halford Mackinder, Miss Gladys Potts, Sir John Russell, Sir Alfred Yarrow, and others. This meeting has been organised for the purpose of directing public attention to the results of an investigation carried out by a special committee, appointed by the Council in 1923. Two reports have already been issued. The Committee hope this year, through this meeting, to emphasise the most important results of their investigation, namely, first, that a growing and widespread demand exists in the Overseas Dominions for boys and girls well educated with an agricultural bias; secondly, that Great Britain has an increasing need of finding healthy and profitable employment within the British Empire for a large number of her sons and daughters; and thirdly, that practical studies of all kinds, especially those related to agriculture, possess a training value far too little realised by parents and by educational authorities.

SECTION M (AGRICULTURE).

The Section will meet under the presidency of Sir Daniel Hall, whose presidential address on the limits of agricultural expansion will form the basis of a joint discussion with Section F (Economics), at which the speakers will include Lord Bledisloe, Sir Thomas Middleton, and Mr. R. J. Thomson Sir Daniel Hall will also open a joint meeting with Section L (Education) on training for overseas life, at which several distinguished people have promised to speak, and at which it is hoped that the president of the Association may be present.

In addition to these two joint discussions, much time will be devoted to sectional discussion, so that the number of individual papers which are being presented is smaller than usual. It is proposed at a sectional meeting to review the present position of agricultural education in Great Britain, and to consider the methods adopted to make available to those engaged or about to be engaged in the agricultural industry the results of scientific research. Another session will be devoted to possible improvements in cultivation methods, both hand and machine, which is a subject with very important practical and economic bearings at this time when the position of arable land farmers is so precarious.

Other subjects of more technical interest which will occupy the Section are those of soil classification and the nutrition of dairy cattle, in which connexion a paper by Sir A Theiler and Drs Green and Du Toit on the minimum mineral requirements of cattle should be of great interest This South African work forms an interesting complement to that carried out at Aberdeen, Cambridge, and elsewhere in Great Britain.

Messrs. Sutton of Reading have kindly invited members of the Section to visit their seed establishment, and a visit will also be made to the Agricultural Department of the University of Reading

Universities of the British Empire.

THE universities of the British Empire are parts of a system dependent for its equilibrium and orderly progress in changing conditions on adjustments of factors making for integration and differentiation. The Congress of Universities of the Empire, which met last week at Cambridge, represents an adjustment on the side of integration. A glance at the lists [1] of subjects discussed at the first and second Congresses, 1912 and 1921, brings out the fact that the subjects of last week's discussions are, like those of 1912, but to an even greater extent, concerned directly with co-operation between universities, whereas the programme of 1921 was of a more open and exploratory character Of the seven subjects of the plenary sessions, five, of the four subjects of sectional meetings, three, were directly and obviously concerned with the question as to how universities in different parts of the British Empire may most effectively help one another. Congresses are sometimes criticised adversely as "leading to nothing," especially where, as in the present instance, the discussions do not culminate in 'resolutions.' It remains to be seen whether the third Congress of the Univer-

[1] "Universities Yearbook, 1926," pp. 12 and 13.

sities of the Empire will merit this criticism, but definite practical suggestions for immediate action were not lacking.

Lord Balfour opened the proceedings of the first session on Tuesday, July 13, the subject of discussion being "The State and the University." The new problems confronting universities arise, he pointed out, not from the social changes of the time so much as from the growth of modern knowledge and its paradoxical correlative, the growth (due to specialisation) of modern ignorance. The former has brought in its train an enormous increase in the expensiveness of the material plant indispensable for the pursuit of the study of science and urgent pressure on the State, and, through the State, on the universities, to develop the applications of science to the problems of industry. In the absence of other sufficient available means of obtaining the wherewithal to provide and maintain the requisite buildings and equipment, the universities of Great Britain have sought and obtained State subsidies, and, even where these have not been ear-marked for work in applied science, have inevitably aroused a natural and pardonable, but dangerous, instinct on the part of the State to control and supervise. Hitherto that instinct has not found expression in Britain in any serious menace of excessive interference, but the universities must ever be watchful lest they betray their trust to cherish the spirit of disinterested research, a dereliction which would in the long run be fatal to the very industrial interests it might be supposed to serve. The sphere in which the universities can at present most fruitfully study to promote the material interests of the community lies in the middle region between fundamental and practical research.

The idea of the duty of watchfulness against State encroachments or enticements proved to be the keynote of most of the discussion which followed Lord Balfour's address. Prof. E. R. Holme, of the University of Sydney, while proudly asserting that in Australia there has never been a sustained public policy that is contrary to the right British tradition, admitted the existence of dangers in the large "and necessary" dependence upon the State which characterises Australian universities. A specially insidious risk is that of political parties being tempted to make capital out of the pride of the people in their university and the desire to spread its benefits—to make, in American parlance, the campus of the university coterminous with the State.

This same danger was touched upon in a paper by President Klinck, of the University of British Columbia, one of the four State (Provincial) universities of Western Canada—who remarked, however, that while the unwillingness of the universities to pander to the expectations of those primarily interested in utilitarian education has led to their disappointment and disillusionment, it has not yet led to any appreciable diminution in the numbers demanding admittance. He was able to assure the Congress that the governors of a State university in Canada are no more liable to be dictated to by the legislature than the governing board of an endowed institution by private benefactors. The academic freedom of the professorial staff in the State universities is even more jealously guarded and more universally respected than is freedom from political interference in matters affecting the financial administration of the universities. The legislatures are not interested in staff appointments or in the details of academic policies, but leave the universities completely autonomous in these respects.

Prof. Holme referred to a recent political agitation of the question of the Australian universities' duty to country students, and, in this connexion, to the commission now studying the project of a Commonwealth University at Canberra for examinational purposes only. He suggested that the University of London might well offer to undertake for Australia the function of such a Commonwealth University. Either plan would have the advantage that Australian universities would not be driven to establishing (as Queensland has done) departments of "teaching by correspondence." Sir Theodore Morison suggested that the proper safeguard against the exertion of undue influence, whether by the State or by benefactors, is to present a bold front and a frank exposition of the grounds of the university's claim to autonomy. Prof. Payne, of Melbourne, quoted an instance of a government offering a chair coupled with the name of a prospective holder—an offer which the university rightly refused.

Sir Alfred Hopkinson summed up the relationship of State and university under five heads: Initiation, which should not be, and in the past has not been in Great Britain, the business of the State; recognition, which should always be in the hands of the State, to prevent fraudulent degree-granting; support, for which, ideally, the university should not be mainly dependent on the State; control, which should not be exercised by the State except to the extent of seeing that State grants are spent on development and not on fancy fads; service, in which there should be close co-operation. This last aspect of the relationship between State and university was presented with some enthusiasm in a speech by Dean Mackay, of the graduate school of McGill University, where, he said, the prevalent attitude towards the State is one, not of watchfulness against imaginary dangers of interference by the State, but of eagerness to promote its welfare. In one respect this has been prejudicial to the university, for it has led to an excessive withdrawal of the most talented alumni for the service of the State in other spheres.

"Co-operation in Research throughout the Empire" was discussed at the morning session of July 14 under the presidency of Lord Londonderry, Chancellor of the Queen's University of Belfast. This session attracted a maximum attendance—between five and six hundred. Sir Thomas Holland outlined the history of the Department of Scientific and Industrial Research and the various other governmental agencies in different parts of the British Empire for promoting and conducting research—agencies which, originating in the necessities of the War, have demonstrated that they are equally indispensable in time of peace. Two questions in connexion with them were, he suggested, of obvious importance to the Congress: "Does the establishment of Government laboratories tend to supplant university functions?" and "Can the universities take further advantage of the new official machinery for correlation and financial support?" To the first the answer seems, he said, to be favourable so far as Britain is concerned, but such official institutions have a strong natural tendency to extend their activities. This tendency is minimised where, as in England, the scope of their work is strictly limited to well-defined, large-scale investigations beyond the capacity of any university to undertake, and the universities are well represented on controlling committees. As regards the second question, he had found at the Imperial College a ready response to suggestion and a willingness to render the necessary financial assistance to research workers.

Sir John Farmer, professor of botany at the Imperial College, suggested that more might be done towards keeping the universities in touch with scientific workers in the outlying parts of the British Empire. The universities might, for example, give assurances that such workers would be welcomed

should they visit the university laboratories when on leave in England. At present the universities seem, he said, scarcely alive to the importance of the great development that is going on in tropical agriculture, and the opportunities open to their graduates in connexion therewith. Dr. Andrew Balfour, of the London School of Hygiene and Tropical Medicine, complained of the ignorance on the part of men working in his field of what others working in the same field are doing. An organisation is badly needed for laying down lines of research, following up what is done, and deciding what results should be recorded and how. India has its Scientific Advisory Board, which advises on the disposal of the Indian Research Fund Association's money, but it has no link with England. A central co-ordinating body in London, possibly a committee of the Medical Research Council, should be established, and one of its most important functions should be the selection and training of personnel. A recent promising move in this direction is the appointment of a Chief Medical Advisor to the Colonial Office.

The same subject, co-operation in research, came up again for discussion on July 10 under the title "The Actual Working of the Ph.D. Scheme." Questions relating to facilities for the migration of university teachers and students were touched on in this discussion, and were dealt with at other meetings under various aspects: interchange; an Imperial policy in education; mutual recognition of examinations; pension schemes The sectional meeting devoted to the discussion of "An Imperial Policy in Education," under the presidency of Sir Frederick Lugard, aroused much interest A paper on the subject was read by Prof Earle, of the University of Hong-Kong, who advocated the formation of a committee with a constitution designed to secure interest in the assistance of educational effort throughout the British Empire, a function which the Universities' Bureau is not competent to undertake

University and Educational Intelligence.

BIRMINGHAM. Applications are invited for the Walter Myers travelling studentship for research in pathology, value 300*l*. for one year. Candidates must be under 30 years of age and graduates in medicine of the University of Birmingham or of some other university in Great Britain or Ireland. In the case of graduates of other universities, candidates must have been students of the Birmingham Medical School for three years immediately preceding their application for the studentship

Further information may be obtained from the Dean of the Medical Faculty, and applications must be lodged with the Dean not later than September 1 next.

CAMBRIDGE.—The late Captain H. E. Laver has bequeathed to the Museum of Archæology and Ethnology his collection "of Chinese and the Far East Archers' Implements, meaning all [his] collection of Bows and Arrows and all implements connected with the manufacture of the same and all [his] Archers Thumb Rings, consisting of Jade and other hard stones of Ivory, Bone, Porcelain, Glass and Metal." One of the conditions of the bequest is that the specimens shall never at any time be lent for exhibition out of the precincts of the University

C. R. N. Winn, Trinity College, has been nominated by the Vice-Chancellor to the Choate Memorial Fellowship at Harvard, and N. H France, St. John's College, to the Princeton Visiting Fellowship. The Harkness Scholarship for geology has been awarded to M. Black, Trinity College, and the Wiltshire Prize to F. W. Shotton, Sidney Sussex College.

The Observatory Syndicate reports the addition of a photo-electric photometer, mainly by Günther and Tezetmeyer, to the equipment of the Observatory. The photometer will be used with the Sheepshanks equatorial.

C. B. Timmis has been elected to the Caldwell Studentship at Corpus Christi College.

MANCHESTER.—The Council has made the following appointments: Mr. H. E. Buckley to be lecturer in crystallography; Miss Margaret S. Willis to be assistant lecturer in geography; Dr. C. E. Brunton to be demonstrator in human physiology; Dr. O. R. Howell, lecturer in applied chemistry in the faculty of technology; Mr. Robert Grindley, demonstrator in chemical technology in the faculty of technology.

THE Air Ministry has announced that five hundred aircraft apprentices, between the ages of 15 and 17 years, are required by the Royal Air Force for entry into the Schools of Technical Training, Halton, Bucks, and Flowerdown, near Winchester They will be enlisted as the result of an open and a limited competition held by the Civil Service Commissioners and the Air Ministry respectively Successful candidates will be required to complete a period of twelve years' regular Air Force service from the age of 18 years, in addition to the training period. Full information regarding the aircraft apprentice scheme, which offers a good opportunity to well-educated boys of obtaining a three-years' apprentice course of a high standard and of following an interesting technical career, can be obtained on application to the Secretary, Air Ministry, Kingsway, London, W C 2.

VACATION courses being held in Germany this summer are described in a 16-page pamphlet published by 'Hochschule und Ausland,' Charlottenburg. Courses for foreigners in the German language and culture are provided by, or in connexion with, the Universities of Berlin, Greifswald, Heidelberg, Jena, Kiel (of special interest to Swedish students), and Marburg. Göttingen (October 4–14) and Munich (September 27–October 9) offer post-graduate medical courses; the Nordic Association of Lübeck is giving (August 2–20) a course of lectures for foreigners entitled "German Light on European Problems" Greifswald has an attractive programme including not only literary, artistic, and philosophical subjects but also astronomical, botanical, chemical, geographical, geological, physical, and psychological. The Jena courses are grouped in ten divisions including philosophy, pedagogy, University extension problems, natural science, domestic science, political and economic science, and German for foreigners.

THE Board of Education announces that the Institution of Naval Architects and the Worshipful Company of Shipwrights have consented to co-operate with the Board in arrangements for the award of national certificates in naval architecture to students in technical schools and colleges in England and Wales. Under the agreement which has been reached, 'Ordinary Certificates' and 'Higher Certificates' will be issued jointly by the Institution and the Company and the Board on the successful completion of approved courses. The scheme will provide only for part-time students. Should the authorities of any school in England or Wales desire further information, their inquiries should be addressed to the clerk to the Worshipful Company of Shipwrights, 4 New London Street, London, E.C.3, in the case of ordinary certificates, and to the secretary of the National Certificates Committee, Institution of Naval Architects, 5 Adelphi Terrace, London, W.C.2, in the case of higher certificates.

Contemporary Birthdays.

July 25, 1848. The Earl of Balfour, K.G., O.M., F.R.S.
July 26, 1872. Prof. Joseph Barcroft, C.B.E., F.R.S.
July 27, 1857. Sir E. Wallis Budge, D.Litt. (Oxon.).
July 27, 1857. Dr. John William Evans, F.R.S.
July 28, 1843. Sir W. T. Thiselton-Dyer, K.C.M.G.
July 28, 1844. Sir Howard Grubb, F.R.S.

The EARL OF BALFOUR, Chancellor of the University of Cambridge, and also of the University of Edinburgh, was born in Scotland. He was educated at Eton and Trinity College, Cambridge. Always deeply interested in the advancement of science, he is a past-president of the British Association, and has, at two separate periods, served on the council of the Royal Society.

Prof. JOSEPH BARCROFT was educated at Bootham School, York, and King's College, Cambridge. He succeeded the late Prof. J. N Langley as professor of physiology in the University of Cambridge, and is also Fullerian professor of physiology in the Royal Institution. His researches on the respiratory function of the blood and its relation to the activity of the tissues form but one department of many physiological inquiries He has explored the conditions of life at high altitudes with persistency and acumen, undertaking the leadership of two expeditions for that purpose, one to Monte Rosa, and another to the High Andes. Prof. Barcroft was awarded a Royal medal by the Royal Society in 1922.

Sir WALLIS BUDGE, Oriental scholar, formerly keeper of Egyptian and Assyrian antiquities in the British Museum, is a graduate of Christ's College, Cambridge. He has conducted excavations at Assuan, Nineveh, in the Sudan, and elsewhere.

Dr. JOHN W. EVANS, lately president of the Geological Society of London, was educated at University College School. He has rendered much service to geological science by initiating, extending, and guiding the conduct of geological investigations in the colonies and dependencies of the British Empire. In western and southern India and in South America he has led official exploring expeditions The Geological Society recognised the high value of his work by awarding him, in 1922, its Murchison medal. Dr. Evans is the author of a useful pamphlet of 20 pp. issued by the Colonial Office in 1914, on "Directions for the Collection of Geological Specimens."

Sir W. T. THISELTON-DYER, who was born at Westminster, attended King's College School, graduating afterwards at Christ Church, Oxford. In 1875 he became assistant director of the Royal Botanic Gardens, Kew, and he was director from 1885 until 1905. The "Flora Capensis," recently completed, and the "Flora of Tropical Africa," which will run to eleven or twelve volumes, will always be associated with his many years at Kew, where he also started the *Kew Bulletin* He has contributed notably to the economic and systematic botany of the British Empire.

Sir HOWARD GRUBB, to whom our hearty congratulations are extended on the occasion of his eighty-second birthday, was educated privately and at Trinity College, Dublin The practical outcome of his skill and labours in the production of objectives and instruments of precision is known wherever there are observatories. Early this year Sir Howard was the recipient of a congratulatory address signed by the leading astronomers and astrophysicists of Great Britain, referring to his resourcefulness and ingenuity in the development of the instrumental equipment of astronomers through more than sixty years.

Societies and Academies.

LONDON.

Optical Society, June 24.—M. von **Rohr**: Joseph Fraunhofer and the development of optical instruments. The position of high-grade optical work at the beginning of the nineteenth century was discussed. The chief cause of the transference from England to Germany of supremacy in telescope construction at that time was the appreciation in the latter country of the importance of fundamental research to the industry. The developments which took place in Munich and later at Benediktbeurn due to Fraunhofer's activities were detailed and some of the more important instruments produced under his direction were described.—T. **Smith**: (1) Reflection as a special case of refraction. Some difficulties which arise in applying the formulæ for refraction to reflection, and particularly the sign conventions which should be adopted for reflection, were discussed. (2) On the light transmitted and reflected by a pile of plates. The properties of a series of media or of a pile of plates which absorb and scatter light, and the interfaces of which may also absorb and scatter as well as transmit and reflect light, were investigated. In general, the ratio of the transmissive factors of a pile of plates in the two directions is independent of all reflective properties of the surfaces, and the factors are equal if the individual transmissive and absorptive factors are the same for the two beams. The ratios of the light transmitted without reflection to the total light transmitted are equal in both directions. The reflective properties of the pile depend upon all the factors of the system, and the ratio of the two reflective factors is not independent of the order in which the plates are placed. In non-absorbing systems, the sum of the intensities of the reflected and transmitted beams is equal to the intensity of the incident beam, and the ratio of the intensity of the reflected to that of the transmitted beam is equal to the sum of the corresponding ratios for the component plates or surfaces of the pile. Such a pile forms an exception to the rule that the reflective coefficients depend on the order in which the plates are arranged.—D. S. **Perfect**: Note on the immutability of transmissive factors with reversal of light. Direct experimental evidence has been obtained that the transmissive factor of the surface separating two media is unaltered if the direction in which the light travels is reversed.

DUBLIN.

Royal Dublin Society, June 22.—P. A. **Murphy**: The downy mildew of onions (*Peronospora Schleideni*), with particular reference to the hibernation of the parasite.—W. R. G. **Atkins** and H. H. **Poole**: Photo-electric measurements of illumination in relation to plant distribution (Part 1). Measurements of the illumination in shaded and open sites have been made by means of two photo-electric photometers and an apparatus already described, the readings being nearly simultaneous. The ratio of the illumination at a shaded site to the illumination due to diffused light in the open forms a useful index for comparing different sites. This ratio is conveniently expressed as a percentage which is called the daylight factor. It is usually found with both the photometers horizontal (so as to measure the vertical illumination), but a useful value near the edge of a wood is that found by tilting the photometer so as to receive the maximum illumination. There is a marked correlation between the flora and the daylight factors of the sites examined.—J. **Reilly** and G. T. **Pyne**: Studies in peat (Part 1). The thermal decomposition of peat under reduced pressure. Distillations of dried peat

were carried out under atmospheric and reduced pressures, and at both low and moderately high temperatures. The vacuum distillations gave larger yields of tar, of the heavier acidic substances, and of paraffin, while those at atmospheric pressure gave larger yields of simpler products such as ammonia, methyl alcohol, acetic acid, and gases. This points to a type of decomposition under low pressure favouring the formation of the more complex intermediate products.—J. **Reilly** and Miss H. E. **Bastible**: The velocity of formation of 3-5-dimethylpyrazole-4-diazonium chloride. The rate of reaction between nitrous acid and the amine was retarded by working in $N/100,000$ solutions. Owing to the great stability of 3-5-dimethylpyrazole-diazonium salts, measurements were possible up to comparatively high temperatures. The reaction is bimolecular, and at 0° C., $K=0.022$, the value increasing regularly with rise of temperature. At 72° C., $K=5.8$, more than 90 per cent. of the nitrous acid being destroyed in two minutes. In a control experiment without the base, less than 1 per cent. of the acid was destroyed in two minutes at 100° C.

PARIS.

Academy of Sciences, June 14.—E. **Goursat**: A problem of the theory of surfaces.—Marcel **Brillouin**: The centre of gravity and moments of inertia of the oceans. The mean action of the earth on the ocean.—Charles **Moureu**, Charles **Dufraisse**, and Paul Marshall **Dean**: A coloured hydrocarbon: rubrene. The substituted phenylacetylene, $(C_6H_5)_2CCl.C:C.C_6H_5$, has been proved to be very unstable, owing to the mobility of the atom of chlorine. If this compound is heated alone in a vacuum, hydrogen chloride is evolved, and from the residue a new hydrocarbon (rubrene) can be extracted, distinguished by its fine orange red colour, high melting point (331° C.), and sparing solubility in ordinary solvents. It combines with four atoms of bromine giving derivatives remarkable for their stability at high temperatures, one melting at 460° C. and another at 500° C., both without decomposition.—A. **Blondel** and A. **Dargenton**: Apparent brilliance of the face of exit of an optical system with any number of thick lenses.—Léon **Guillet**: The cementation of copper and its alloys by aluminium. As cementing agent an aluminium copper alloy (aluminium 20 per cent.) was used, the powdered alloy being mixed with 5 per cent. of ammonium chloride. Details of the results of experiments with various alloys are given, including the depth of penetration, hardness of the surface, and microscopic structure of the surface.—Charles **Nicolle** and Charles **Anderson**: Recurrent fever transmitted both by Ornithodorus and by lice. Sadi de Buen has recently announced the existence in Spain of a special type of recurrent fever, not transmitted by lice, but by *Ornithodorus marocanus*. These experiments were made on rats, but the author now proves that if monkeys are substituted for rats, the Spanish recurrent fever can be transmitted both by lice and by Ornithodorus.—N. E. **Nörlund** was elected corresponding member for the Section of Geometry in succession to the late Cl. Guichard.—Bertrand **Gambier**: Voss-Guichard surfaces.—Gaston **Julia**: Correction to the note on the polynomials of Tchebichef. Admitting priority to D. Jackson and G. Polya.—E. **Lainé**: Equations of the form $s=f(x, y, z, p, q)$ which are of the first class.—Jacques **Risler**: The formation of luminescent helium tubes. Details of the methods of purifying the helium and cleaning the tubes from foreign gases.—D. K. **Yovanovitch** and Mlle. A. **Dorabialska**: A new method for measuring the absorption of the β- and γ-radiation of radioactive bodies. The usual method consists in measuring the ionisation produced by the energy remaining in the rays after traversing several layers of material: the method now proposed is to measure calorimetrically the energy retained by the material itself in the form of heat.—**Frilley**: Absorption of the penetrating radiation of actinium in equilibrium with its derivatives.—René **Dubrisay**: Researches on surface actions. Solutions of various dyes (methylene blue, congo red, methyl orange, etc.) were shaken with absorbent materials (sand, kieselguhr, asbestos, cotton) and the quantity of dye adsorbed measured colorimetrically. The addition of an electrolyte, sodium chloride, increased the amount adsorbed in every case.—P. **Mondain-Monval**: The thermal properties of the various varieties of selenium. The heat of transformation of vitreous selenium into metallic selenium at 130° C. was found to be 13·5 cal. per gm., and that of red crystallised selenium at 150° C. into metallic selenium, 2·2 cal. per gm.—A. **Kirrmann** and H. **Volkringer**: The absorption in the ultra-violet of two isomers. The substances compared were the two bromoheptenes, $C_5H_{11}-CH=CHBr$ and $C_5H_{11}-CBr=CH_2$.—L. **Barthe** and E. **Dufilho**: The estimation of sodium: applications. A modification of the method of Blanchetière suitable for material containing organic matter or phosphates. The sodium is precipitated as the triple acetate of uranium, magnesium, and sodium.—B. **Bogitch**: The removal of iron from copper and nickel matte.—Charles **Prévost**: The two stereoisomeric α-ethylene-γ-glycols.—P. **Russo**: The presence of three transported beds in the southern Rif.—Pierre **Termier**: Remarks on the preceding communication.—**Pouget** and **Chouchak**: The radioactivity and chemical composition of the mineral waters of Hammam des Ouled Ali.—Ignace **Puig**: The large electromagnetic disturbances of the four first months of 1926 according to the records of the Observatory of Ebro, Tortosa, Spain.—André **Dauphiné**: New experiments on the vascular relations between the leaf and the root.—B. P. G. **Hochreutiner**: A new genus, intermediate between the Malvaceæ, the Bombacaceæ and the Sterculiaceæ.—L. **Blaringhem**: The production of double flowers as a result of complex crossings between divergent species of Geums (Rosaceæ).—G. **Mouriquand**, M. **Bernheim**, and Mlle. **Theobalt**: The antirachitic power of Wood's light. The radiations corresponding to Wood's light possess a protective action against the development of experimental rickets.—R. **Legendre**: The presence of two sea birds in the stomach of *Lophius piscatorius*.—R. **Courrier**: The quantitative action of the follicular hormone.—Em. **Perrot** and M. **Rouhier**: *Yocco*, a new drug containing caffeine. The bark of the stem of a plant known as Yocco grown in Colombia, especially in the Putumayo and Caqueta regions, is used as a stimulant by the natives. The bark contains about 2·7 per cent. of a crystalline substance presenting all the characters and reactions of caffeine.

ROME.

Royal Academy of the Lincei, May 16.—O. M. **Corbino**: Perot and Fabry fringes obtained with a half-silvered doubly refracting plate.—Federico **Sacco**: The tunnel at Drink (Valle d' Aosta). A representation is given of the stratigraphic metamorphic crystalline series traversed by the tunnel at Drink.—Angelo **Tonolo**: Equations for the conformable representability of a three-dimensional variety of Euclidean space.—Alessandro **Terracini**: The geometrical signification of the projective normal.—G. **Horn-D' Arturo**: The theory of flying shadows. The recent suggestions of Armellini and Ronchi with regard to the origin of flying shadows during solar eclipse are refuted, the author re-asserting his view that the light

intervals of these shadows represent real images of the solar crescent.—Giorgio **Abetti**: The structure of the *Hα* line of the chromosphere.—Filippo **Burzio**: Some new properties of ballistic precession.—E. **Persico**: Magnetic rotatory polarisation in an alternating field.—Ubaldo **Barbieri**: Astronomical determination of latitude and azimuth made at Cape Noli in 1911.—Ramiro **Fabiani**: First results of new investigations in the Permian outcrops in the Sosio basin (Palermo).—Enoch **Peserico**: The manner in which the electrical conductivity of the submaxillary gland is modified during its functional activity (ii.).—Giulio **Savastano**: Non-productivity of the pistachio in Sicily. Faulty fertilisation due to lack of pollen, rather than adverse climatic conditions or ovular abortion, is the principal cause of non-productivity.—P. **Pasquini**: Ineffective closing of the blastopore and subsequent development of the segmented ovum of *Rana esculenta* subjected to rapid centrifugation.—Constantino **Gorino**: The microflora of the Italian silo.

WASHINGTON, D.C.

National Academy of Sciences (Proc. Vol. 12, No. 5, May).—L. H. **Adams** and R. E. **Gibson**: The compressibilities of dunite and of basalt glass and their bearing on the composition of the earth. Direct measurements were made of the cubic compressibilities in the pressure range 2000 to 12,000 megabars (1 megabar = 1·0197 kgm./cm.^{2} = 0·987 atmos.). Assuming change of compressibility with pressure is a function of the compressibility, the compressibilities of dunite are $0·84 \times 10^{-6}$ and $0·79 \times 10^{-6}$ reciprocal megabars at 2000 and 10,000 megabars pressure respectively. The velocities of longitudinal waves at these pressures would be 7·9 km./sec. and 8·2 km./sec. Seismological data indicate that the velocity for longitudinal waves at 60 km. depth increases suddenly from 5·9 km./sec. to about 8 km./sec. The average compressibility of basalt glass was $1·45 \times 10^{-6}$ for the above pressure range, giving a velocity for longitudinal waves of 6·45 km./sec. The results suggest the existence below 60 km. of ultra-basic rock.—Edwin B. **Frost**, Storrs B. **Barrett** and Otto **Struve**. Radial velocities of 368 helium stars. Of these stars, 158 are spectroscopic binaries the periods of revolution of which are mostly only a few days. Using 350 stars, those brighter than mag. 2 have an average residual velocity of 6 km./sec., while for those fainter than mag. 5·3 it is 12 km./sec. The remainder have intermediate velocities.—George E. **Hale**: Visual observations of the solar atmosphere. The spectrohelioscope is of value for detecting exceptional phenomena quickly, while observations can readily be made with light of different wave-lengths. The chromosphere, prominences, spots, and faculæ can be investigated, and the instrument affords a means of searching for solar magnetic and electric phenomena. In the laboratory it should prove of service in the study of arcs, sparks, and other light sources with lines of various types.—William C. **Bray** and Hal D. **Draper**. Capillary condensation and adsorption. Sorption isotherms have been found for water vapour on partially hydrated oxides of copper and manganese, and mixtures of them in the form of porous granules. There is a rapid increase of sorption at higher pressures due to condensation of liquid in the capillaries. This occurs only when the surface, covered with a monomolecular layer by adsorption, is sufficiently curved.—Cecil D. **Murray**: The physiological principle of minimum work. (ii.) Oxygen exchange in the capillaries. The principle of minimum work can be applied to the circulation in the arterial system and in the capillaries. The general conclusion is that a minimum principle holds in physiology; the internal environment is in a state of mobile equilibrium, its components settling down to a new equilibrium with new constraints.—Cesar **Uribe**: Nuclear division in the trophozoites of *Endamœba histolytica*. Stained preparations were made of the intestine of a cat experimentally infected. A consecutive series of stages of nuclear division in trophozoites is described. Cloudy material forming two polar masses and an "axial band" in which the spindle is embedded appear to arise from the karyosome. The polar masses are surmounted by two clear cones with a centriole at the apex of each. The number of daughter chromosomes is estimated as six.—D. L. **Hopkins**: The effect of hydrogen-ion concentration on locomotion and other life-processes in *Amœba proteus*. Optimum conditions for growth and reproduction of Amœbæ from both acid and alkaline solutions occur at about pH 6·7 and pH 7·6. Locomotion, measured by sketching a pseudopodium with a camera lucida at minute intervals, shows similar optimum points. A neutral solution seems to cause a marked change in permeability, leading to decreased movement and vitality.—A. F. **Blakeslee** and J. L. **Cartledge**: Pollen abortion in chromosomal types of Datura. The size and condition of the pollen is an indication of the chromosomal group to which a plant belongs.—Edward **Condon**. Remarks on penetrating radiation. (*a*) Assuming that an electron is a sphere of negative electricity of uniform density and that a proton is a point charge, it is calculated that the 'neutron' can execute simple harmonic motion with a frequency of the same order as that of Millikan's penetrating radiation. (*b*) Using a corrected absorption law to accord with the geometrical conditions of Millikan's experiment, the results suggest that the radiation observed is truly homogeneous. There are difficulties in accepting the 'neutron' postulated.—Edwin H. **Hall**. New evidence in favour of a dual theory of metallic conduction. This theory gives an explanation of the Peltier development of heat observed by Bridgman, where an electric current changes direction within a metal crystal.—R. de L. **Kronig**. (1) The magnetic moment of the electron. (See NATURE, April 17, p. 550.) (2) A theorem of space quantisation.—E. O. **Salant**: On the heat capacity of non-polar solid compounds. Taking Born's theory of the heat capacities of crystalline solids and assuming a mean vibration in all directions for the molecule, terms are obtained expressing the contributions to heat capacity by (*a*) molecular vibrations, (*b*) bond frequencies (determined by characteristic bond frequencies in the infra-red), and (*c*) vibrations of the atoms across their bonds.—Robert S. **Mulliken**: Systematic relations between electronic structure and band-spectrum structure in diatomic molecules (iii.). Molecule formation and molecular structure.—Richard C. **Tolman** and Sinclair **Smith**: On the nature of light. G. N. Lewis has suggested that an atom never emits a quantum of radiation except to another atom, the possibility of transmission being determined by the laws of interference. His crucial experiment of arranging a mirror on a pivot in order to detect the effect of reflexion of quanta from one half only, those from the other half being forbidden by interference laws, is considered inadequate. The suggestion is made that a radiation field contains both waves and light quanta, the latter carrying energy and the former providing a signalling system. When and where both wave and quantum theory permit, the action of light occurs.—Einar **Hille**: On Laguerre's series (iii.).—Tracy Yerkes **Thomas**: On conformal geometry.—R. L. **Moore**: Concerning indecomposable continua and continua which contain no subsets that separate the plane.

Official Publications Received.

Department of the Interior: U.S. Geological Survey. Water-Supply Paper 548: Surface Water Supply of the United States, 1922. Part 3: Ohio River Basin. Pp. vi+262+2 plates. 25 cents. Water-Supply Paper 563: Surface Water Supply of the United States, 1923. Part 3: Ohio River Basin. Pp. vi+258+3 plates. 25 cents. Water-Supply Paper 567: Surface Water Supply of the United States, 1923. Part 7: Lower Mississippi River Basin. Pp. iv+122+3 plates. 15 cents. Water-Supply Paper 572: Surface Water Supply of the United States, 1923. Part 12: North Pacific Slope Drainage Basins. A: Pacific Basins in Washington and Upper Columbia River Basin. Pp. v+193+ii+3 plates. 25 cents. Bulletin 780D: Antimony and Quicksilver Deposits in the Yellow Pine District, Idaho. By Frank C. Schrader and Clyde P. Ross. (Contributions to Economic Geology, 1925, Part 1.) Pp. iv+137-167+plates 18-19. Bulletin 785A: Recent Developments in the Aspen District, Colorado. By Adolph Knopf. (Contributions to Economic Geology, 1926, Part 1.) Pp. ii+28+1 plate. Professional Paper 146: Mississippian Formations of San Saba County, Texas. By P. V. Roundy, George H. Girty and Marcus I. Goldman. Pp. iv+63+33 plates. 35 cents. (Washington, D.C.: Government Printing Office.)

Bird Sanctuaries Committee (England). Report for 1925. Pp. 15. (London: H.M. Office of Works.)

Proceedings of the United States National Museum. Vol. 68, Art. 9: North American Species of Two-winged Flies belonging to the Tribe Miltogrammini. By Harry W. Allen. (No. 2610.) Pp. 106+5 plates. Vol. 68, Art. 10: Field Notes on Gall-Inhabiting Cynipid Wasps, with Descriptions of New Species. By Lewis H. Weld. (No. 2611.) Pp. 131+8 Plates. Vol. 68, Art. 20: A new Genus and Species of Borborid Flies from South America. By Mario Bezzi. (No. 2621.) Pp. 6. Vol. 68, Art. 21: New Genera and Species of Acalyptrate Flies in the United States National Museum. By J. R. Malloch. (No. 2622.) Pp. 35+2 plates. Vol. 68, Art. 23: North American Two-winged Flies of the Genus Cylindromyia Meigen (Ocyptera of Authors). By J. M. Aldrich. (No. 2624.) Pp. 27+1 plate. Vol. 69, Art. 2: The Optical Properties and Chemical Composition of Glauconite. By Clarence S. Ross. (No. 2628.) Pp. 15. (Washington, D.C.: Government Printing Office.)

Year Book of the Academy of Natural Sciences of Philadelphia for the Year ending December 31, 1925. Pp. 100+8 plates. (Philadelphia, Pa.)

Research Publications of the University of Minnesota. Bibliographical Series, No. 3: Research in Progress at the University of Minnesota, July 1924—July 1925. Compiled by Dr. Clarence M. Jackson. Pp. vi+306. (Minneapolis, Minn.) 1.25 dollars.

Department of the Interior: Bureau of Education. Bulletin, 1925, No. 45: Statistics of Universities, Colleges and Professional Schools, 1923-24. Pp. 161. (Washington, D.C.: Government Printing Office.) 25 cents.

Astronomical and Magnetical and Meteorological Observations made at the Royal Observatory, Greenwich, in the Year 1924. Under the Direction of Sir Frank Dyson. Pp. 8+Axxiii+A55+iv+B22+C7+Dix+D85+5+Exxii+E76+21. (London: H.M. Stationery Office.) 37s. 6d. net.

Researches of the Department of Terrestrial Magnetism, Vol. 5: Ocean Magnetic and Electric Observations, 1915-1921. Magnetic Results, by J. P. Ault; Atmospheric-Electric Results, by J. P. Ault and S. J. Mauchly. Special Reports: The Hudson Bay Expedition, 1914, by W. J. Peters; Navigation of Aircraft by Astronomical Methods, by J. P. Ault; The Compass-Variometer, by Louis A. Bauer, W. J. Peters and J. A. Fleming; Sunspot and Annual Variations of Atmospheric Electricity, with Special Reference to the *Carnegie* Observations, 1915-1921, by Louis A. Bauer; Studies in Atmospheric Electricity based on Observations made on the *Carnegie*, 1915-1921, by S. J. Mauchly. (Publication No. 175.) Pp. vii+430+15 plates. (Washington, D.C.: Carnegie Institution.) 7.25 dollars.

Papers from the Department of Marine Biology of the Carnegie Institution of Washington. Vol. 23: Some Marine Bottom Samples from Pago Pago Harbor, Samoa, by M. N. Bramlette; Proportions of Detrital Organic Calcareous Constituents and their Chemical Alteration in a Reef Sand from the Bahamas, by Marcus I. Goldman; Report on a Bacteriological Examination of 'Chalky Mud' and Sea-Water from the Bahama Banks, by N. R. Smith; Recent Foraminifera from Porto Rico, by J. A. Cushman; Fossils from Quarries near Suva, Viti Levu, Fiji Islands, and from Vavao, Tonga Islands, with Annotated Bibliography of the Geology of the Fiji Islands, by Wendell C. Mansfield; Miocene Corals from Trinidad, by T. W. Vaughan and J. E. Hoffmeister. (Publication No. 344.) Pp. ii+134+15 plates. (Washington, D.C.: Carnegie Institution.) 2.50 dollars.

Papers from the Department of Marine Biology of the Carnegie Institution of Washington. Vol. 24: Taxonomy of the Amebas, with Descriptions of Thirty-nine new Marine and Freshwater Species. By Prof. Asa Arthur Schaeffer. (Publication No. 345.) Pp. iii+116+12 plates. (Washington, D.C.: Carnegie Institution.) n.p.

Human Metabolism with Enemata of Alcohol, Dextrose and Levulose. By Thorne M. Carpenter. (Publication No. 369.) Pp. ix+197. (Washington, D.C.: Carnegie Institution.) 2.25 dollars.

Contributions to Embryology. Vol. 17, Nos. 85 to 89. No. 85: Development of the Human Embryo during the period of Somite Formation, including Embryos with 2 to 16 pairs of Somites, by George W. Bartelmez and H. M. Evans; No. 86: Origin and Development of the Rete Ovarii and the Rete Testis in the Human Embryo, by Karl M. Wilson; No. 87: Physiological Study of Cortical Motor Areas in Young Kittens and Adult Cats, by Lewis H. Weed and Orthello R. Langworthy; No. 88: Lymphatics and Blood-Vessels of the Ovary of the Sow, by Dorothy H. Anderson; No. 89: Relation of Onset of Decerebrate Rigidity to the Time of Myelinization of Tracts in the Brain-Stem and Spinal Cord of Young Animals, by Orthello R. Langworthy. (Publication No. 362.) Pp. iii+140+27 plates. (Washington, D.C.: Carnegie Institution.) n.p.

Proceedings of the Board of Agriculture in India held at Pusa on the 7th December 1925, and following days; with Appendices. Pp. iv+154. (Calcutta: Government of India Central Publication Branch.) 1.14 rupees; 3s. 3d.

Patents for Inventions: including some Useful Information on Trade Marks, Designs and Copyright. By Benj. T. King. Pp. 16. (London: King's Patent Agency, Ltd., 146a Queen Victoria Street, E.C.4.) Free.

Observatoire de Zi-ka-wei. 1122 étoiles doubles de J. Herschel: étudiées d'après les catalogues photographiques et les cartes-du-ciel. Par le Rev. P. Gauchet. (Annales de l'Observatoire de Zô-sè, Tome 14, Fascicule 3.) Pp. B72. (Zi-ka-wei, Chang-hai.)

Canada. Department of Mines: Geological Survey. Memoir 144, No. 128 Geological Series: Mount Albert Map-area, Quebec. By F. J. Alcock. (No. 2088.) Pp. ii+75+6 plates. 20 cents. Memoir 147, No. 127 Geological Series: Michipicoten Iron Ranges. By W. H. Collins, T. T. Quirke and Ellis Thomson. (No. 2079.) Pp. iii+175+9 plates. 30 cents. Economic Geology Series, No. 1: Geology and Economic Minerals of Canada. By G. A. Young. (No. 2065.) Pp. iv+187+57. 50 cents. (Ottawa: F. A. Acland.)

Leeds Tercentenary Celebrations. Report of the Tercentenary 'Clean Air' Committee, July 1926. Pp. 52. (Leeds: Walter Gardham.) 3d.

A Bibliography on Research: Selected Articles from the Technical Press, 1923, 1924, 1925. Pp. 46. (New York: National Research Council.)

The Royal Society for the Protection of Birds. Thirty-fifth Annual Report, January 1st to December 31st 1925: with Proceedings of Annual Meeting, 1926. Pp. 108. (London: 82 Victoria Street, S.W.1.) 1s.

Proceedings of the Imperial Academy. Vol. 2, No. 4, April. Pp. vii-xi+149-191. (Ueno Park, Tokyo.)

Annalen van de Sterrewacht te Leiden. Deel 12, Stuk 3: New Mathematical Theory of Jupiter's Satellites. 1 and 2: The Intermediary Orbit and the Variations. By Prof. W. de Sitter. Pp. ii+83. Deel 14, Stuk 3: Measures of Double Stars made with the $10\frac{1}{2}$-inch Clark-Repsold Refractor in the Years 1920-1925. By W. H. van den Bos. Pp. 88. (Haarlem: Joh. Enschedé en Zonen.)

Diary of Societies.

MONDAY, JULY 26.

CAMBRIDGE PHILOSOPHICAL SOCIETY (in Cavendish Laboratory), at 4.30.—Dr. P. A. M. Dirac: On Quantum Algebra.—Miss B. Swirles: The Polarisabilities of Atomic Cores.—J. R. Oppenheimer: On the Quantum Theory of the Problem of the Two Bodies. (Preliminary Communication.) *Communicated by title only*: M. H. A. Newman: Integral Invariants of the Affine Field.—Dr. A. Young and Prof. H. W. Turnbull: The Linear Invariants of Ten Quaternary Quadrics.—G. S. Mahajani: A Contribution to the Theory of Ferromagnetism.—E. B. Moullin: On some Resistance Properties of a Certain Network containing Inductances and Capacities, and their Analogies in a Mechanical System.—J. C. Burkill: On Mellin's Inversion Formula.—Major P. A. MacMahon: The Elliptic Products of Jacobi and the Theory of Linear Congruences.—R. Hargreaves: Geodetic and Dynamical Principles, a Comparison and Connexion.—J. R. Oppenheimer: On the Quantum Theory of Vibration-Rotation Bands.—P. A. Taylor: An Approximation to the Motion of Two Rotating Electrical Doublets in a Plane.—D. R. Hartree: Some Relations between the Optical Spectra of Different Atoms of the same Electronic Structure: II. Aluminium-like and Copper-like Atoms.—J. P. Gabbatt: Note on the Extension to Higher Space of a Theorem of Wallace.—J. B. S. Haldane: A Mathematical Theory of Natural and Artificial Selection. Part III.

CONFERENCES.

JULY 26 TO 31.

FRENCH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (at Lyons).

AUGUST 3 TO 6.

INTERNATIONAL PHYSIOLOGICAL CONGRESS (at Stockholm).

AUGUST 16 TO 23.

INTERNATIONAL BOTANICAL CONGRESS (at Cornell University).

AUGUST 23 TO 28.

AUSTRALASIAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (at Perth, Western Australia).—Prof. E. H. Rennie: The Chemical Exploitation, Past, Present and Future, of Australian Plants (Presidential Address).—The Presidents of Sections and the Titles of their Addresses are as follow: *A* (*Astronomy, Mathematics and Physics*), Prof. K. Grant, Atomic Transformation; *B* (*Chemistry*), Prof. J. Kenner, Some Aspects of the Problem of Molecular Structure; *B 2* (*Pharmacy*), A. T. S. Sissons, The Indebtedness of Pharmacy to Organic Chemistry; *C* (*Geology and Mineralogy*), Sir Douglas Mawson, The Igneous Rocks of South Australia—a brief Survey of Present Knowledge relating thereto; *D* (*Zoology*), Prof. L. Harrison, The Composition and Origins of the Australian Fauna, with special reference to the Wegener Hypothesis; *E* (*Geography and History*), Prof. E. Scott, The Discoveries of the Western Australian Coast, with especial reference to Dampier and D'Entrecasteaux; *F* (*Ethnology and Anthropology*), Prof. F. Wood Jones, The Claims of the Australian Aboriginal; *G* (*Social and Statistical Science*), Major L. F. Giblin, Federation and Finance—an Examination of the Financial Relations of States to a Federal Commonwealth; *H* (*Engineering and Architecture*), Sir John Sulman, Town Planning; *I* (*Sanitary Science and Hygiene*), F. S. Hone; *J* (*Mental Science and Education*), P. Board, Social and Economic Values in Education; *K* (*Agriculture and Forestry*), C. E. Lane Poole, Forestry and Land Settlement; *L* (*Veterinary Science*), Prof. J. D. Stewart, The Relationship of Veterinary Science to the Prosperity of the State; *M* (*Botany*), Prof. A. J. Ewart, Past and Future Development of Botanical Science; *N* (*Physiology and Experimental Biology*), Prof. W. A. Osborne, The Study of the Reflex.

AUGUST 26.

MEDICAL WOMEN'S INTERNATIONAL ASSOCIATION (at Prague): Discussions on Tuberculosis and Pregnancy; Women Police-surgeons.

NATURE

SATURDAY, JULY 31, 1926.

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The Practice of Forestry in the British Empire.

THE practice of forestry as a science has been a plant of slow growth in the British Empire. Many reasons have contributed to this cause, the chief being the facility with which we have been able to obtain our requirements, either by imports from closely adjacent forests belonging to our Continental neighbours, as in Great Britain, or from the existing primeval forests, as in India and the great Dominions and Colonies. Forestry as a science on a par with agriculture has long been known and practised in many of the great European States. A study of the methods employed and the comparative ease with which forest property, both belonging to the States and to private proprietors, is managed and protected, will show that not only the people on the countryside, but also even the dwellers in the towns, and the great industrial classes, understand the value of forest property and to some extent the aims of a forest policy—that, in effect, the forest, in the economy of the countryside, has an equal value with the tracts devoted to agriculture.

Many motorists from Great Britain annually make the journey from the north to the south of France and pass through great tracts of forest, either in State or private ownership and managed with an efficiency which has long been unknown, or at least unpractised, in Britain. They will have remarked upon the absence of fences. Boundary ditches there may be, or hedges, but little in the nature of the artificially constructed fences so necessary at present in Great Britain if the forest areas are to be safeguarded from a public to whom their economic value to the nation at large is unknown, and from that pest the rabbit. During the War thousands of men and women from the British Empire must have seen some of the forests of France, but very few possessed even the little knowledge of forestry practice which would have enabled them to recognise the differences which underlie the management in France and in Britain; or to have appreciated one of the most essential necessities for the successful practice of forestry in a country—that the public should be so far educated as to understand its true value to themselves and therefore to respect and help in the protection of forest areas.

It is unfortunately a not uncommonly accepted idea in Great Britain that a proper conservation of forest tracts means entire closure and the prohibition of picnic parties, and so forth; or that the introduction of rational management into such areas of forest as have come down to us from early times in the form of Crown forests, *e.g.* the Forest of Dean, New Forest, etc., entails their destruction as beauty spots or what are

termed ' playgrounds ' for the public. The controversy which recently took place in the press in connexion with certain beautiful spots in the New Forest—old decrepit woods of admittedly great beauty and picturesqueness—is a case in point. It has had its counterpart in the past in the case of other beauty spots in Great Britain, and even outside Great Britain in other parts of the Empire. The enunciation of such opinions, often by men whose names carry weight with public opinion, incontestably proves that what may be termed a forestry ' sense ' is at present lacking in the British public and, it may be added, in the Empire public, if we except perhaps India. The growth of this forestry ' sense ' can only arrive with the young generations and through the schools; it is an asset for the future that some schools in Great Britain and the Empire are introducing the teaching of the elements of forestry and its potential value into their curricula.

The love, which is strong in the British, for the maintenance of beauty spots and old woods, is a perfectly natural one and an attribute which any race may be proud to possess. Where trees and woods, however, are in question, it will be conceded that, unlike old historic buildings and famous ruins, no Government department, such as that for the protection of Ancient Monuments, with which the late Lord Curzon was so closely identified, both in India and Great Britain, can maintain them in perpetuity. Each succeeding generation which clamours to maintain untouched, for example, the afore-mentioned old woods in the New Forest, is merely assuring the disappearance from England at no distant date (though they themselves may not live to see it) of one or more famous beauty spots. Yet, as the Continent of Europe well shows, to those possessing the education and knowledge to be able to see and appreciate the management of such problems, it is quite possible to put in practice a method of management which, whilst assuring the minimum of change in artistic values, for forestry and the cult of trees is a lengthy business, will preserve for future generations what the present ones are enjoying.

This is but one aspect of the practice of forestry science, far removed from the commercial aspect, but one in which, owing to the interest aroused, it is of the first importance that the present generations should endeavour to make themselves acquainted with—if only in the interests of their future posterity and the maintenance of many beautiful spots and regions in Great Britain.

That the introduction of and practice of scientific forestry within the Empire has come to stay appears assured from the fact that the Prince of Wales is setting an example to the country by his personal interest in the subject. As president of the Empire Forestry Association, he delivered an address at the annual meeting in March last. As would be expected from the Prince of Wales, he dealt with the matter from the Empire point of view. He alluded to the ten-years planting programme of 150,000 acres undertaken by the Forestry Commission in Great Britain, which it was hoped to complete within the next three years; he then discussed the present position of forestry in South Africa and the planting schemes being carried out in that country to provide its population with "the conifers which Nature has denied them," and the work upon which Canada, Australia, and New Zealand are engaged.

Perhaps as great and, in some cases, greater advances have been made in the many forestry services, some already of considerable age, under the Colonial Office in the Malay States, Nigeria, Gold Coast, Kenya and the other East African colonies, and elsewhere. But the greatest of all, in point of progress, is the case of India. The first scientific forest service inaugurated in the British Empire was commenced in that country more than sixty years ago. A paper dealing with the practice of forestry read in the north of Great Britain a short time ago commenced with the sentence, "Forestry is a new industry which is happily growing up within the Empire, and nowhere more rapidly than at home." In the past, and at the present day, the Empire has often been accused of working in watertight compartments, and the practice of forestry is no exception to the rule. India is the only country within the Empire at the present day in which it can be said that forestry as a science, occupying its place in the economy of the countryside and in the true interests of the people as a whole, has become recognised and appreciated alike by the statesman, the cultivator, and to a considerable extent by the more educated of the public outside the great towns. The *Journal of the Empire Forestry Association*, to the value of which the Prince of Wales alluded in his address, has clearly exhibited to the trained forest officer the position which forestry science and practice has attained in India—a position which in some parts of the country vies with the best to be seen on the Continent of Europe. A study of the lines of management and work in the Indian forests and the research work which has been carried out, especially in connexion with the utilisation of tropical timbers, will be as useful to many of our Empire forest officers as the studies they have made in Europe.

It would not be in the true interests of forestry in Great Britain to say that, within the short space of time which has elapsed since the Forestry Bill was passed by Parliament some seven years ago, the industry—or, to give it its true name, since the industrial is but one side

of the business—the science of forestry has as yet made great strides. A beginning has been made, but forestry cannot hope to take its real place in the economy of the nation or of the Empire as a whole until the public has become educated and has accepted its aims and objects, alike from the economic and amenity points of view.

E. P. STEBBING.

Science and Psychical Research.

The History of Spiritualism. By Sir Arthur Conan Doyle. In 2 vols. Vol. 1. Pp. xiii + 342 + 8 plates. Vol. 2. Pp. vii + 342 + 8 plates. (London, New York, Toronto and Melbourne: Cassell and Co., Ltd., 1926.) 42*s*. net.

THE recent publication of two large volumes entitled "The History of Spiritualism" by Sir Arthur Conan Doyle is perhaps a suitable occasion on which men of science may once again turn their thoughts in a direction in which many more of them are probably interested than would be willing to admit it. Spiritualism is a cult, a faith, or perhaps even a full-blown religion, the central tenet of which is sufficiently well stated by Sir Arthur (vol. 2, p. 263) in the following words:

"A belief in the existence and life of the spirit apart from and independent of the material organism, and in the reality and value of intelligent intercourse between spirits embodied and spirits discarnate."

Spiritualism as a religion does not come within the confines of the subjects which a scientific periodical like NATURE may appropriately discuss. But right through the warp of Sir Arthur's book, though by no means carefully distinguished, and most certainly very unscientifically handled, runs the woof of psychical research, which is, or at any rate purports to be, the *scientific* study of what are called *supernormal phenomena*. These phenomena are of two kinds—(*a*) *physical*, such as telekinesis, or movement of solid objects without contact; independent voice, or the production of sound recognisable as that of the human voice and recordable objectively on a dictaphone; the formation of the substance known as ectoplasm or teleplasm; psychic lights and cold breezes; formation of structures invisible except by the reflection of ultra-violet rays; and so on: (*b*) *mental*, such as clairvoyance, clairaudience, automatic script, telepathy and other similar types of phenomena not involving the use of material objects.

Many years ago, when this question of psychical research was brought to his notice, Huxley replied, "Supposing these phenomena to be genuine, they do not interest me." We are sorry to be obliged to have to record so unscientific a remark from so great a man, and even sorrier to have to admit that Huxley's attitude is still that of the great majority of biologists at the present day. The opinion of any man, however great, or of any body of men, however influential, on a subject which they deliberately refuse to investigate, either because it "does not interest" them, or because of a preconceived idea that the phenomena involved are necessarily fraudulent, is really not worth much. It is a sad commentary on human nature that, even at the present day, when the reality of some at least of these phenomena has surely been put beyond the shadow of a doubt by the work of such men as Lodge and Richet, no scientific man can take up the study of psychical research without 'losing caste' and undergoing either secret or more or less open persecution from his fellows. Truly, we have not got very far from the Middle Ages after all, and there is a very real danger that organised science in the twentieth century is taking its seat in the very chair from which it once drove the medieval church. "E pur si muove" applies equally to the movement of the earth round the sun or to the movement of a levitated table upwards against gravity without visible support. The former was no more incomprehensible and no less anathema to the medieval church than the latter is to-day to organised science. But the spirit of to-day is different from that of the past, and martyrdom no longer wins many converts. Modern Galileos may undergo persecution for what they hold to be the truth, but the modern world will soon forget them in the hurry and rush of modern life, and the truths for which they suffer will perish with them unless they can be presented in such a form as to appeal to the reason of mankind.

It is just here that a great danger lies. The history of the world is full of evolutionary failures; for every organism, Nature selects a path from which there is no turning back. The advance of science during the past seventy years has been definitely along the road to materialism. Though the pace has somewhat slackened and many an anxious glance is now being turned backwards, yet the impetus is still driving us forward mainly in the same direction. For hundreds of years mankind looked to religion to lead them along the right path. Now, in the western world, their gaze is fixed on science. It is certain that, for the next hundred years at any rate, where science leads, there mankind will follow. Are we, the men of science, the leaders of mankind, so absolutely sure of the path along which we are travelling?

Pilate's question "What is Truth?" has never yet been answered, and perhaps it never will be. It is, however, the duty of science to search diligently for truth and to leave no avenue unexplored in which it may be found. The broad highway may lead us to

destruction, even if it appears well marked out and easy to travel upon. The neglected side-path, foul with mire and overgrown with noxious weeds, may be the real entry into the Promised Land, for which we are searching. But because of the foul mire, and because of the noxious weeds, organised science refuses to explore this side-path, in spite of the fact that a few brave spirits, more adventurous than the rest, a Crookes, a Lodge, a Richet, have penetrated into the thicket and returned to report both progress and promise.

The present writer cannot claim the experience either of a Lodge or a Richet in the study of psychical research. His interest in the subject is one of comparatively recent growth and arises chiefly from dissatisfaction with the adequacy of present-day biological theories to explain life in acceptable terms. He can, however, claim sufficient experience to be able to say, with both Lodge and Richet, that a clear case has been made out for psychical research, and that it is the duty of science to recognise the genuineness of the phenomena and to attempt to explore them. Fraud exists, and always has existed, in all branches of human affairs. It is even blatantly active in biology, to judge by the remarks passed quite recently by leading British and American biologists on the work and character of a certain Austrian professor. Let fraud and cheating be exposed, certainly, wherever it exists; but is that any reason for refusing to accept as a recognisable branch of science any subject in which fraud has been found?

It appears to the writer that the best avenue of approach for men of science to make on this subject is the study of the so-called physical phenomena. Either these are entirely fraudulent (that is, due to conscious or subconscious cheating on the part of the medium), or else they extend the realm of physics beyond the boundaries explored at present. Take, for example, one of the simplest and most easily experienced of the physical phenomena, that of *cold breezes*, which generally precede any manifestation of greater energy in a séance. It has been maintained that this effect is purely subjective, that the sitters imagine they feel the cold owing to the tense situation created in the mental atmosphere of the séance room. In the National Laboratory of Psychical Research, two very accurate thermographs have recently been installed. One of these is placed against the wall of the room, far from the sitters, while the other records the changes which occur in the temperature of the closed cage of the Pugh table in which phenomena occur during sittings with the medium Stella C. in red light.

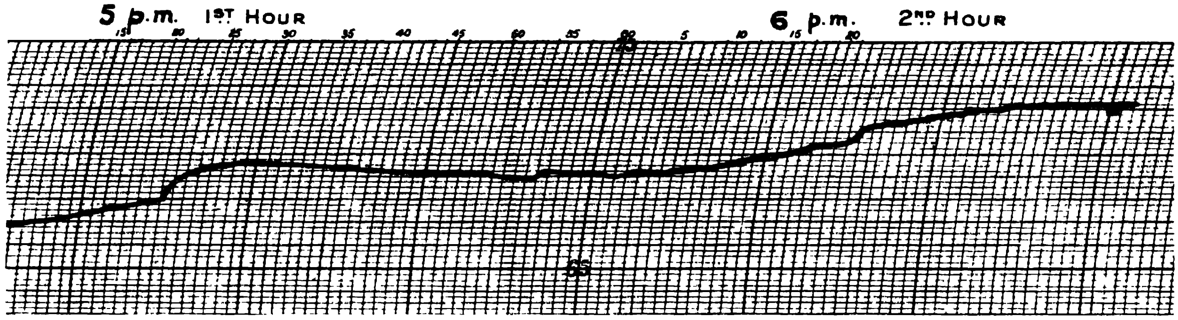

FIG. 1.—Thermograph record inside Pugh table. Temperature at 5.10 P.M., before beginning of séance, 67° F. Red light throughout.

5.23 P.M. Stella goes into trance. Marked rise in temp.
5.30 to 5.55 P.M. Steady fall in temp.
5.55 P.M. Electric bell with contact inside closed cage was rung vigorously four times within a minute or two. Note irregularity in thermograph record.
6.24 P.M. Bright light flashed inside cabinet.
6.29 P.M. Zither pushed partly out of opening in Pugh table.
6.33 P.M. Two very fine blue flashes inside Pugh table.
6.42 P.M. Stella comes out of trance.

Note.—Cold breezes preceded each of these phenomena. Other phenomena were also recorded at 5.30, 5.42, 5.48, 5.51, 5.58, 6.01, 6.05, 6.07, 6.[illegible], 6.16, and 6.18 without any sudden variation of thermograph record.

The control thermograph record taken separately on the wall of séance room, about 10 feet from the medium sh[illegible] a steady rise in temperature without any marked changes in gradation from 67° F. at 5.10 P.M. up to 69.5° F. at end of séance.

Normally, when a number of people sit in a closed room, the temperature mounts steadily upwards; this is also the case for the temperature of the séance room as recorded on the wall during a sitting. But the record of the temperature inside the Pugh table shows a steady rise at first, followed by a fall during the production of supernormal phenomena, as in the accompanying record (Fig. 1); there are also several marked sudden changes at points where special phenomena occurred. These careful experiments prove the objective nature of the cold breezes and present us with a purely physical problem, which is surely worth solving. It is not an extravagant hypothesis which finds an explanation for the production of 'supernormal' physical phenomena in the withdrawal of heat from the circle of sitters, such heat being turned into some other form of energy, possibly of a kind not yet investigated officially by science!

The so-called 'physical' phenomena of mediumship

should be of interest to biologists as well as to physicists, because, if they are genuine, they offer an avenue towards the study of the control and manipulation of matter by mind which is at present unique in its character. The invisible operators who apparently control the more striking phenomena of mediumship claim that they are able to draw out from the organism of the medium 'psychic stuff,' by the moulding of which they can produce at will the phenomena of independent voice, levitation, materialisations of portions of their personalities, and so on. We who have seen these things done under conditions precluding deliberate fraud are not fools, but in full possession of keen faculties. Every man who witnesses these phenomena and becomes convinced of their reality has only two choices before him. He can, as numbers have done, keep quiet and say nothing about it, thereby preserving the respect of his fellow-scientists and committing the sin against the Holy Ghost, namely, turning his back on truth when he has recognised it; or he can, like Sir Oliver Lodge, speak out the truth boldly and allow his reputation to drop in the estimate of his fellow-men. The writer ranges himself alongside Sir Oliver, well knowing what is in store for him in consequence. This article is a plea for a wider and more generous outlook on the part of science towards these phenomena. Science has nothing to fear from fraud; it need only go on applying its experimental method to any problem, and a solution will shape itself in time, either in the form of an overwhelming proof of the fraudulent production of the phenomena, or pointing towards the existence of genuine supernormal results.

The mind of man seems to have reached out so far in recent years that it has almost succeeded in exploring the entire limits of its own cage. Is it to rest in the belief that there is nothing at all outside that cage, or may it, so to speak, extend a cautious paw outside the bars and begin to feel its way towards a realisation that there may be another world outside? Psychical research may perhaps afford the only possible way of exploring the unknown territory outside the cage.

R. J. TILLYARD.

Civil Aviation in the United States.

Civil Aviation: a Report by the Joint Committee on Civil Aviation of the U.S. Department of Commerce and the American Engineering Council. Pp. xvii + 189. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1926.) 12*s*. 6*d*. net.

IN Europe rapid developments have been made in the application of aircraft to commercial uses. In the United States, however, air transportation, in spite of many conditions naturally favourable, has not achieved a development commensurate to the opportunities.

The Department of Commerce and the American Engineering Council, recognising this deficiency, have for some time past gathered information relating to this matter. A joint committee was formed in June 1925, to make a comprehensive survey of the economic aspects of aviation throughout the world, and to recommend the measures necessary to encourage a national development of commercial aviation in the United States. All available sources of information on this subject have been examined by the committee, including the attitude of American business interests and the experience of aircraft operators.

In the report before us, which here deals comprehensively with the situation, the committee lays down first and foremost the development of the commercial side of aircraft as of vital importance both to industry and to national defence. Whilst stressing the fact that development must mainly depend on private initiative and enterprise, the committee maintains that provision of facilities essential to this development is a public responsibility, and, if these facilities are provided, direct subsidies to civil aviation in the form of money grants are both unwise and unnecessary.

Certain fundamental difficulties, the committee maintains, are retarding the development of this venture in the United States. Broadly speaking, they are intimately associated with the lack of an established Government policy to encourage civil and industrial uses of aircraft; with the lack of commercial aircraft and equipment best adapted to commercial operation; and with the consequent want of public and business confidence and support.

After due consideration of the large part played by the commercial department and by big businesses in this field, the committee recommends a number of far-reaching proposals which, if adopted, would undoubtedly make a ground-work for a vast new development eminently suited to the geography of the United States. It is proposed that Congress should enact a civil aeronautic law providing for the establishment of a Bureau of Civil Aeronautics in the Department of Commerce; that is to say, it is to be completely dis-associated from the military or naval wing. It would be the function of this bureau, among other duties, to regulate civil air navigation, license pilots, and inspect machines; to develop, establish, and take over air routes and facilities, and generally to encourage and promote the aircraft industry on the civil side.

The committee, moreover, recommends that the several States should authorise their municipalities to acquire landing fields out of public funds and to lease them when necessary. Great stress is laid on the fact

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that the Government should not undertake any non-military flying activities, but that it should be left entirely within the scope of private operation. Even air mails, forest patrol, agricultural, entomological, and coastguard services, aerial photography, map making, etc., should be conducted by private agencies under contract wherever possible. Much assistance, however, is expected from the Government departments; the war, naval, and other departments are to permit the use of Government landing fields and to provide facilities for commercial operations. The Post Office should retire from the ownership and operation of air mail routes as soon as it is possible to contract with responsible private operators. The purchases of Government aircraft are to be arranged to conform to a definite and continuous programme which will give the greatest aid to the industry, and State encouragement is to be extended to the exportation of commercial aircraft.

Whilst much of the report is thus concerned with the part to be played by private owners, under security and assurance which is to be granted to those who are thus encouraged to invest their capital in the industry, scarcely any mention is made of that form of research and development which would be vital to maintain such an industry in the forefront of technical and scientific knowledge. There does occur a bald statement that the Government should carry on fundamental aeronautical research in the interests of civil aviation, but, unlike the other sections of the recommendations, this aspect does not appear to have been expanded, or its far-reaching implications grasped. From the point of view of the corresponding industry in Great Britain, it will be an interesting experience to watch how these proposals work themselves out in practice.

Military Explosives and Gases.

Explosifs, poudres, gaz de combat: leçons professées à la Faculté des Sciences de Lille. Par Paul Pascal. Pp. viii + 296. (Paris: J. Hermann, 1925.) 35 francs.

THIS book embodies the lectures delivered by Prof. Paul Pascal, of Lille, to candidates for the French Service des Poudres. While in Great Britain the Royal Naval College and the Artillery College afford specialised instruction to combatant officers in the subject matter of these lectures, in France this is also obligatory for chemical engineers destined for employment in the Government factories.

The first part of the book deals with the different aspects of explosive reactions, such as the temperature and pressure of explosion, its propagation on one hand by the explosive wave, and in the case of propellants by rapid burning, along lines which have been developed by the French masters in this subject, such as Berthelot, Vieille, Sarrau, and Le Chatelier.

The second and third parts deal with the manufacture of explosives, together with the properties of several of the more important ones. Naturally, in a book of this size, manufacturing details cannot be exhaustively given, and the treatment is sometimes unequal. At the same time, several of the processes used in Great Britain are accurately described, such as the displacement process for making nitroglycerine of Nathan, Thomson and Rintoul, and the displacement process for making nitrocellulose of the Thomsons.

The production of explosives derived from aromatic hydrocarbons was greatly hampered by France's loss of territory containing coke ovens, and acknowledgment is made of the assistance afforded by Great Britain in sending over benzol, the partition being roughly that while we kept the toluene to ourselves, France was supplied with the benzol from which were made phenol and its derivatives so largely used in French explosives during the War.

The occurrence of isomerides in the nitration of toluene is clearly described, as well as the large-scale methods for making trinitrotoluene. Thus attention is directed to the important features of the process developed in Great Britain, such as the detoluation of the waste acids and the process for continuous nitration of mononitrotoluene, a sketch of a nitrating vessel used here in the large factories being included. Mention is also made of the purification of the trinitrotoluene by alcohol and by sodium sulphite, although the principle of the latter process, which was developed first in France, is not described. As would be expected from the use of nitronaphthalenes in France for many years, their manufacture is fully illustrated, as is also that of synthetic phenol and its nitro derivatives, including a sketch of a continuous nitration process developed in this country for picric acid.

The manufacture of nitric peroxide and its use in aerial bombs, in which the fuel for this oxidising material was kept apart until the bomb was launched on its flight, are also described, this being a type of bomb that was used to some extent by the French when it was desired to have a very violent local effect.

Sections are devoted to the manufacture of gunpowder and also to the mixture of ammonium nitrate with the nitronaphthalenes, but little is said of the British Service high explosive amatol (ammonium nitrate and trinitrotoluene), the use of which it is understood the French were contemplating on a larger scale towards the end of the War.

Under smokeless propellants a description is given of the methods of manufacture of Poudre B, and the

French views are stated as to the stabilising action of amyl alcohol and diphenylamine. As a war measure these substances were sometimes omitted, and the nitrocellulose propellant was tinted red as a distinguishing mark. While the composition of British cordite MK. I. is correctly given, cordite M.D., which superseded it, is not mentioned; the composition, however, is given of cordite R.D.B. adopted by Great Britain for land service during the War, as it utilised the solvent ether-alcohol instead of acetone which was impossible to obtain in the quantities required. There is a short section on the preparation and properties of the initial detonants, mercury fulminate and lead azide.

The fourth part deals with gases used in warfare, and after a short statement as to their first employment and subsequent tactical use, proceeds to describe the different natures of 'gas,' lachrymatory, toxic and vesicant, sternutatory, etc., and the manufacture of various types. The longest description is given to mustard gas, for the making of which the different processes are compared; the French method of reacting on ethylene with a mixture of chlorides of sulphur approaching sulphur dichloride in average composition and dissolved in carbon tetrachloride is given in some detail.

Sections are also devoted to compounds of arsenic, their physical constants, such as density and vapour tension; in some cases figures are given illustrating methods of manufacture of these bodies.

This book should prove of interest to the technical expert, not only from the presentation of its subject matter, but also as it gives reasoned views sometimes at variance with those held in Great Britain. While the explosive subjects are treated in a manner suitable for the students to whom they are addressed, there would seem to be insufficient information on the properties of the explosives. Thus the book would have been more valuable if it had included some collected information giving the heat produced on detonation of the different types of explosives and their chemical stability, their sensitiveness, rates of detonation, and explosive effects.

Our Bookshelf.

Manual of the New Zealand Flora. By T. F. Cheeseman. Second edition, revised and enlarged by the Author. Edited by W. R. B. Oliver. Pp. xliv + 1163. (Wellington, N.Z.: W. A. G. Skinner, 1925.) n.p.

THE appearance of the long-expected second edition of Cheeseman's manual is most welcome, and, as the editor remarks, "the present edition of the manual will long remain the standard work on the flora." It is much to be regretted that Mr. Cheeseman died before the work was completed; but his full notes on the unfinished portions have enabled Mr. Oliver to complete the book according to Mr. Cheeseman's original ideas.

The value of the new edition is shown in the fact that 192 additional species, the greater number of which are new to science, are enumerated therein. In the family Compositæ alone 40 additions have been made, while in Scrophulariaceæ 25 new plants have been recorded, 19 of these being included in the genus Veronica. All but one of these latter belong to the very critical section Hebe (now considered a separate genus). A useful feature is Mr. Oliver's continuation of the history of botanical discovery in New Zealand, covering the years 1905–24, in which he gives references to the more important work done on the flora and cites broadly the places of publication. The list of Mr. Cheeseman's publications is an apt tribute to the writer of the manual, and at the same time valuable for purposes of reference. The lists of introduced species and native names have also been revised and enlarged and are of great value to the student. It is to be hoped that a fuller treatment of the former will not be long delayed.

In the body of the book the most notable feature is the replacement of Bentham and Hooker's system by that of Engler and Prantl in the arrangement of the families. Although this brings the manual into line with many modern floras, it is doubtful if such an alteration is advisable at the present time, when systems of classification are again under consideration. It is also rather a pity that the sub-kingdoms, classes, and sub-classes are not separated from one another adequately in the text, in accordance with the synoptical key given in the appendix.

In detail the arrangement of the text follows closely that of the first edition. One difficulty which is encountered in working with the manual in herbaria is the absence of collector's numbers in the enumeration after each species, but this, of course, does not arise in the field. Nevertheless, with the exception of a few minor mistakes, especially in the references, the general arrangement and finish of the book reach a high standard.

In spite of the many additions, the book has been kept within approximately the same compass by a slight enlargement of the pages, so that the whole volume is still easily handled.

Ticks: a Monograph of the Ixodoidea. By George H. F. Nuttall, C. Warburton and L. E. Robinson. Part 4: *The Genus Amblyomma.* By Dr. L. E. Robinson. Pp. xii + 302 + 8 plates. (Cambridge: At the University Press, 1926.) 20*s*. net.

THE genus Amblyomma is by far the richest in species of the genera of ticks, comprising many forms remarkable for the beauty of their ornamentation. Dr. L. E. Robinson considers the number of valid species to be eighty-six. Although not of such great importance as carriers of disease as some other genera—for example, the cattle ticks (Boophilus), also the genera Rhipicephalus and Dermacentor—the genus Amblyomma includes several forms very injurious to domestic animals. The South African 'Bont tick' (*Amblyomma hebræum*) is the principal transmitter of heartwater—

a disease frequently fatal to sheep, goats, and cattle. This tick and some allied species are known to cause very severe ulcerating sores, sometimes leading to the loss of one or more udders of the host. Pyæmia and other complaints of horses due to soil-infesting organisms are also believed to ensue from the bites of *Amblyomma variegatum* and allied forms. Live-stock infested with these ticks sometimes suffer greatly from loss of blood and 'tick worry' due to the large number of parasites present. The larvæ of *Amblyomma cajennense*—a common tick in the West Indies, Central and South America—are a great plague, freely attacking man and domestic animals.

Clear and concise descriptions of all the known species of Amblyomma are given in this work, and the illustrations are numerous and excellent. A few notes on biology are to be found at the end. Parthenogenesis is recorded as occurring in *Amblyomma dissimile* and *A. rotundatum*. The author is to be congratulated on producing a monograph which will certainly be of the greatest value to all scientific workers interested in the Ixodoidea, and will no doubt for many years remain the standard work on the genus Amblyomma.

A. S. H.

Die Kriegsschauplatze 1914–1918 geologisch dargestellt. In 13 Heften. Herausgegeben von Prof. Dr. J. Wilser. Heft 2 (zu Heft 1 gehörig): *Lothringen.* Von Prof. Dr. E. Kraus. Mit einem Beitrag (Abschnitt Jura) von Dr. W. Kluptel. Pp. viii + 212 + 4 Tafeln. 24 gold marks. Heft 3: *Zwischen Maas und Mosel.* Von Prof. R. Lais. Pp. iv + 116. 13·50 gold marks. Heft 13: *Sudostmazedonien und Kleinasien.* Von Prof. Dr. O. H. Erdmannsdoerffer, Prof. Dr. Cl. Lebling, Prof. Dr. K. Leuchs, Dr. K. Osswald, Dr. A. Wurm. Pp. v + 114 + 4 Tafeln. 18·60 gold marks. (Berlin: Gebrüder Borntraeger, 1925.)

THE conception of a series of volumes portraying the geology of the War areas as such has little to commend it either from the scientific or from any other point of view. Apparently numerous geologists were attached to the German Imperial staff to advise on such matters as water-supply, building materials, and the laying of mines; in the present volumes the results of their investigations are brought together.

Of the three now before us, the first two deal with areas of the western battle front, and give a fairly detailed account of the local stratigraphy and tectonics; there seems to be but little new matter, the contents being mainly a digest of information long ago published elsewhere. The volume on south-east Macedonia and Asia Minor consists of a series of articles recording the original observations of several geologists, who give most attention to tectonic structure; a few are accounts of hurried traverses, but a number of districts are surveyed in some detail.

The Effects of Inanition and Malnutrition upon Growth and Structure. By Prof. C. M. Jackson. Pp. xii + 616. (London: J. and A. Churchill, 1925.) 30*s.* net.

PROF. JACKSON'S book is a systematic review of the subject of inanition, which term he uses to indicate the lack of food or of any food-stuff which is essential to the living organism. The general outline is on a strictly anatomical basis, the effects of starvation and malnutrition being considered separately for each system of the body. There are also included chapters on the effects of inanition on plants, protozoa, and the higher invertebrates. The book is singularly complete. The author not only gives the results of his own researches into the subject, but reviews in the widest possible manner the literature of the last fifty years. He classifies the various states of inanition according to their character, degree, duration and severity, and mode of occurrence, and discusses fully the results of experimental starvation and the observations of morbid anatomists on cases of clinical malnutrition and deficiency diseases. Being a study from the morphological aspect, the book is of theoretical rather than practical interest to the physician, but it will be warmly welcomed by the pathologist and biologist. It is well indexed, and a very full bibliography is included.

The Works of Aristotle. Translated into English under the Editorship of Prof. W. D. Ross. *Categoriæ* and *De Interpretatione*, by E. M. Edghill; *Analytica Priora*, by A. J. Jenkinson; *Analytica Posteriora*, by G. R. G. Mure. Pp. 348. (Oxford: Clarendon Press; London: Oxford University Press, 1926.) Paper, 6*s.* net; cloth, 7*s.* 6*d.* net.

THE monumental work of the English translation of all the writings of Aristotle by the Oxford Aristotelian Society, under the editorship of Prof. W. D. Ross, has received its latest accession in this volume, which contains four of the logical treatises. They constitute the work of Aristotle which is usually placed at the beginning and about which there is the least difficulty and the smallest amount of controversy. More than anything else, more even than the "Metaphysic," they are responsible for the idea of 'authority' which attached itself to the name of Aristotle throughout the Middle Age. This edition makes it possible for the English reader to understand how the philosopher Immanuel Kant could cite logic as the example of a science which had emerged complete and perfect from its first formulation, and take it as the model of the work he himself proposed to do for metaphysics.

Physikalisch-chemische Mineralogie und Petrologie: die Fortschritte in den letzten zehn Jahren. Von Prof. Dr. Wilhelm Eitel. (Wissenschaftliche Forschungsberichte: Naturwissenschaftliche Reihe, Band 13.) Pp. viii + 174. (Dresden und Leipzig: Theodor Steinkopff, 1925.) 8 gold marks.

THIS is a welcome addition to the series of which it forms part. Within the limits of its scope, it is an invaluable guide to the results of recent investigations on the physics and chemistry of minerals and rocks. It is not intended to supersede larger works such as that of Boeke; but to constitute a supplement by which the student of the subject may bring his knowledge up-to-date. Similar publications are to follow on kindred subjects. It will be noticed that the author speaks of "Petrologie," not "Petrographie," as he is concerned with the evolution, not the mere discription, of rocks.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Spirals and Waves in Wool.

ALL the Merino wool imported from Australia and South Africa is characterised by a conspicuous waviness throughout the individual lock or staple (Fig. 1). When drawn out, each separate fibre exhibits a regular series of convexities and concavities, and it is the adjustment of these to one another which gives the waviness to the complete lock. They are permanent structural features, returning after the elastic fibre has been stretched. The degree of the waviness, whether close or open, shallow or deep, varies in individual fleeces, and affords a ready means by which the farmer and manufacturer estimate the fineness or

FIG. 1.—Staple of coarse Merino wool showing waves or crimp

coarseness of the wool, from which the 'spinning count' is largely determined.

Much discussion has taken place recently as to the manner of formation of this waviness, whether determined by unequal lateral growth of the fibre within the follicle or superimposed later by the mechanical conditions in the fleece. A comparison of the fine, compact, short Merino wool with the coarse, open, long wool of many of the British breeds is found to afford a satisfactory solution of the problem. In the first instance, examination has been made of the natal coat of a large series of Merino, Karakul, and British breeds of sheep, and these show a remarkable degree of similarity, despite the conspicuous differences which the adult fleeces display. In all instances the coat of lambs at, and shortly after, birth is constituted of short spiral tufts, curls or ringlets of wool, usually intermingled with larger, coarser, medullated fibres known as kemp, and representing the outer coat of primitive sheep (Fig. 2). The spirals reach their most regular and compact form in the natal coat of the Karakul, and it is this which gives the attractiveness of the so-called Astrakhan fur. They are well shown as close, distinct spirals in the Merino and Southdown, and as loose and more open in the curl in the coarse, straight wool of the Scotch blackface, but all intermediate stages can be obtained by comparing different breeds, or even from within a single breed. It is significant of the common origin of all the varieties

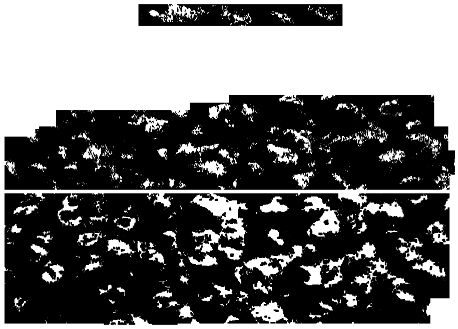

FIG. 2.—Natal fleece of Southdown with spiral tufts or ringlets under an outer coat of kemp fibres.

of sheep that at this early stage of their ontogeny their woolly coats should bear such a close resemblance.

Enclosed as the unborn lamb is within the fœtal membranes, and surrounded by the amniotic fluid, it is clear that the individual fibres, however close or scattered, can have little or no mechanical influence upon one another, and each one is free to assume the form impressed upon it by its structure. Therefore the spiral form they assume in the natal coat may be deemed to be that given them from their growth within the follicle, and to represent, as it were, the natural form of the fibre.

With the continuance of fibre growth after birth, new factors are introduced which modify the natural spiral form. If the staples are sufficiently free from one another as to be unimpeded in their growth, each

FIG. 3.—Staples of lamb's wool with spiral tufts (mother hair) at tip and wavy wool below.

continues the natal spiral form, and we get the well-known ringlets of the Leicester, Lincoln, and Wensleydale, as well as of the Angora goat. If, however, the fibres are so closely arranged that the staples press upon one another and form a compact fleece, then each lock is mechanically unable to assume the independent spiral form and the wavy structure is produced. The change can be best illustrated by compressing a rather open spiral of wire, the spire when flattened assuming a wave-like form, altogether resembling the waviness in the wool fibre. All

degrees of transformation of the spiral lock into the flattened wave can be traced in such fleeces as the Border Leicester, according as the staples are free throughout their length ('locky') or compact below for a greater or lesser part of their length.

The change from spiral to wave is also recognisable in the first coat of sheep having a short compact fleece, as in the Merino and Southdown. At birth, as already remarked, the coat consists of independent spirals, maybe with an outer coat of kemp. The spirals grow upwards as the tip of the corresponding lock or staple and retain their form, while the wool below is in waves or crimps (Fig 3). The spiral tips, known to the farmer as 'mother hair,' enable the woolman to determine wool of the first from later shearings.

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June 17.

The Reduction of Carbon Monoxide.

F. FISCHER (*Brennstoff Chem.*, 7, 97, 1926), in describing the formation at atmospheric pressure of solid, liquid and gaseous hydrocarbons by passing a mixture of carbon monoxide and hydrogen over a variety of catalysts, has advanced the theory that hydrocarbon formation depends on the transient formation of high carbon carbides which, by the action of hydrogen, give rise to products similar to petroleum. He states that no acids or other oxygenated substances are formed.

We have confirmed the formation of liquid hydrocarbons by passing an artificial water gas over a catalyst consisting of reduced manganese, cobalt and copper oxides (*Fuel*, 5, 263, 1926). Further experiments have shown the possibility of synthesising oxygenated compounds from this gas mixture, at ordinary pressure, although the literature available on the subject seems to indicate that pressure is essential for the production of such compounds. From thermodynamic considerations (Matignon), the reaction $CO + 2H_2 \rightarrow CH_3OH$ is scarcely possible at atmospheric pressure and $CO + H_2 \rightarrow HCHO$ cannot be carried out at all The following reactions are perhaps possible:

$$2CO + 4H_2 \rightarrow C_2H_5OH + H_2O$$
$$3CO + 5H_2 \rightarrow CH_3COCH_3 + 2H_2O.$$
$$2CO + 2H_2 \rightarrow CH_3COOH.$$

In an experiment where a gas mixture (composition 53·9 per cent. carbon monoxide and 41·6 per cent. hydrogen) was passed at atmospheric pressure over a contact mass consisting of the reduced oxides of manganese, cobalt and copper, impregnated with 0·5 per cent lithium carbonate at 302° C., we obtained evidence of the formation of products apparently similar to those obtained in the now well-known high-pressure reactions between these gases over certain catalysts

In this experiment 1·2 c.m. of the gas mixture gave 1·4 gm. of a yellow oil not miscible with water, and water-soluble acids equivalent to 0·33 gm of potassium hydroxide. The steam distillate from this solution of potassium salts of the acids, on distillation through a column, gave about 0·5 c.c of a pleasant smelling liquid with a boiling range of 74-80° C. This liquid possessed a ketonic odour and gave the iodoform reaction in the cold, but did not readily reduce ammoniacal silver nitrate. Reducing substances were present in the aqueous part of the fractionated liquid. There was also formed 0·5 gm. of solid which blackened on exposure to light and air.

The theory of the intermediate formation of carbides advanced by Fischer does not suffice to explain the formation of oxygenated compounds.

It is possible that the hydrocarbons he obtains are formed by the dehydration of alcohols followed possibly by hydrogenation, but again this does not explain the absence of acids and ketones from the products obtained by him at atmospheric pressure.

If the view is accepted that catalysis is an acceleration of reactions already taking place, then the formation of organic substances, other than methane and carbon dioxide, must depend on the preferential acceleration of the definite reactions which give rise to them. In the case considered here the question is complicated by the probability that not only does hydrogenation take place, but also oxidation, dehydration, and possibly polymerisation.

The reaction stages, if any, which lead to methane from carbon monoxide and hydrogen are possibly

$$CO + 3H_2 \rightarrow CH_2O + 2H_2O \rightarrow CH_3OH + H_2$$
$$\rightarrow CH_4 + H_2O$$

and

$$CO + H_2O \rightarrow CO_2 + H_2$$

Up to the present, however, the formation of formaldehyde and methyl alcohol has not apparently been established at ordinary pressure without the intervention of extraneous sources of energy such as ultra-violet light, X rays, etc

The formation of oxygenated compounds and hydrocarbons may also be regarded as being preceded by the hypothetical formation of methyl alcohol, which is converted, according to the catalyst and the experimental conditions, into methane or into other substances. Thus the reaction may proceed in consecutive stages or the catalyst may accelerate one or more of the thermodynamically possible reactions from carbon monoxide and hydrogen. No doubt, where a mixed product of aldehydes, ketones, acids and hydrocarbons is obtained, both of these courses may be followed.

Manganous oxide, cobalt and copper are not generally considered to have dehydrating powers as catalysts, but Medsforth (*J Chem Soc*, 123, 1452, 1923) has explained the action of nickel in methane formation as being partly of a dehydrating nature, while the addition of oxide with dehydrating properties leaves the nickel more free to accelerate the hydrogenation stage of reaction. Nevertheless, we are of the opinion that the majority of the products obtained, in which acids, alcohols, ketones, aldehydes and hydrocarbons are all probably present, are formed simultaneously rather than consecutively Carbon dioxide, water and methane would have to be considered in formulating chemical equations for the reactions involved.

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The Spark Spectrum of Lithium.

IT has been shown by Schuler and the present author that the first spark spectrum of lithium (the Li II spectrum) is of the same type as the arc spectrum of helium and consists of two spectral systems. In a letter published in NATURE of October 17, 1925, a scheme of those terms of the lithium spark spectrum was given, which must be considered as analogous to the terms of the ordinary 'doublet' spectrum of helium (the orthohelium spectrum). In this note the results of further research on the lithium spark spectrum will be given. A number of new spark lines has been found which makes it possible to establish a series scheme of the terms of the lithium spark spectrum which are analogous to the terms of

the singulet spectrum of helium (the parhelium spectrum).

To distinguish between the two spectral systems it is proposed to denote the system, which by analogy with the parhelium spectrum must include the normal state of the spectrum, the p-system of the lithium spark spectrum (abbreviated the Li II p-spectrum), while the other by analogy with the orthohelium spectrum will be denoted as the o-system of the lithium spark spectrum (the Li II o-spectrum). As observed first by Schüler (*Ann. d. Phys.*, 76, 292, 1925), and confirmed by recent observations by the author, the Li II o-spectrum is not a doublet spectrum, but seems to be a triplet spectrum of a type different from the ordinary triplet spectra.

Table I. gives the wave-lengths of the lines belonging to the Li II p-spectrum, and their series notation. The numbers in brackets are the estimated intensities of the lines, relatively to the lines of the o-spectrum given in my former letter (*l.c.*). It will be seen that the p-spectrum as a whole is considerably weaker than the o-spectrum. A similar behaviour is observed in helium under the same conditions of discharge, the parhelium spectrum being weaker than the orthohelium spectrum. Table II. gives the terms derived from the lines in Table I., with the effective quantum numbers (n^*) added in brackets.

TABLE I.

5037·8 (1).	$3P$-$4S$	2952·7 (0·5)	$3S$-$5P$
4788·8 (1·5)	$3P$-$4D$	2767·0 (1)	$3P$-$6D$
4677·7 (2)	$3D$-$4F$	2730·7 (0·5)	$3D$-$6F$
4156·3 (0·5)	$3S$-$4P$	2508·9 (0·3)	$3D$-$7F$
3305·2 (0·5)	$3P$-$5S$	1681·8 (2)	$2P$-$3D$
3249·8 (1)	$3P$-$5D$	1755·4 (3)	$2P$-$3S$
3199·4 (1·5)	$3D$-$5F$		

TABLE II.

$3S$ = 51300 (n^* = 2·925)	$3D$ = 48803 (n^* = 2·999)
$4S$ = 28484 (n^* = 3·926)	$4D$ = 27448 (n^* = 3·999)
$5S$ = 18080 (n^* = 4·927)	$5D$ = 17464 (n^* = 4·999)
	$6D$ = 12200 (n^* = 5·990)
$2P$ = 108264 (n^* = 2·014)	
$3P$ = 48328 (n^* = 3·014)	$4F$ = 27434 (n^* = 4·000)
$4P$ = 27244 (n^* = 4·014)	$5F$ = 17550 (n^* = 5·000)
$5P$ = 17440 (n^* = 5·017)	$6F$ = 12193 (n^* = 6·000)
	$7F$ = 8057 (n^*

The value of the term $2S$ has not been found. An extrapolated value of this term ($2S$ = 120000) shows that the line $2S$-$2P$ is in the infra-red at about λ8500 Å.U., and for $2S$-$3P$ (λ about 1400 Å.U.) no line has been observed which with certainty could be ascribed to this transition. It is not possible to give the value of the $1S$-term corresponding to the normal state. The excitation potential of the $2s$-$2p$ line seems to be about 60 volts, and from this the ionisation potential for the Li^+ ion can be estimated to be about 70 volts, which gives the value 550000 for the $1S$-term and for n^* a value between 0·85 and 0·90.

The scheme given in Table II. is in good agreement with the theoretical expectations. For the theory of the spectrum of an atom with two electrons, the reader is referred to a paper by W. Heisenberg, soon to appear, and a paper by I. Waller.

A remarkable feature is that the two strong lines 2934 Å.U. first reported by Mohler, and the line 3715 Å.U. first reported by Schüler, seem, contrary to what was previously assumed, not to belong to the series of the ordinary lithium spark spectrum. From a kind communication from Dr. Paul Foote, the author learns that Dr. Schüler has arrived at the same conclusion.[1] The excitation voltage of these lines is nearly the same as that of the strong green Li II- line ($2s$-$2p$). In addition to these two lines, two rather strong lines at 4607·4 Å.U. and 2337·0 Å.U. have been observed, which seem to be of the same character.

SVEN WERNER.
Universitetets Institut for teoretisk Fysik,
Copenhagen, June 16.

[1] *Note added in the proof.*—Since the above was written a short paper by Schuler (*Z. f. Phys.*, **37**, 568, 1926) has appeared, containing the results of his recent measurements in the Li II p-spectrum. The results given in his paper and in the present note confirm and supplement each other. S. W.

The Distribution of Red Algæ in Relation to Illumination.

WE have recently been engaged in photo-electric measurements of submarine illumination, as a result of which certain conditions governing the distribution of algæ have become evident.

The illumination in the water is reduced in amount and altered in spectral character, and these effects are composite. First, there is the absorption due to the water, as such, which results in the longer wave-lengths being reduced in far greater proportion than are the blue and violet. Grein has shown how surprisingly large the ultra-violet transmission may be in very clear water. Secondly, there is the non-selective absorption due to gross particles in suspension; this merely reduces the illumination and might be more correctly termed scattering or reflection than absorption; but as it can only be measured by the absorption coefficient of the water as a whole, the term absorption is used. Thirdly, there is the selective absorption or scattering due to very small particles, which have most effect upon the ultra-violet, violet, and blue. Fourthly, there is the selective absorption due to any tint in the water occasioned by substances in solution, as in the clear amber water of bog pools.

Determinations of the coefficient of absorption were made under various conditions by means of a photo-electric cell sensitive mainly to the blue. Values of μ were obtained as follows: near shore, with water obviously sandy, μ = 0·81; same spot in calm weather, μ = 0·105; about 20 miles from land in calm weather, μ = 0·110. Consider now the illumination at 10 metres depth, taking that immediately below the surface as unity; with sandy water the illumination at 10 m. was only 0·033 per cent., on the calm day it was 19·2 per cent. and 20 miles out 33·5 per cent. In pure water 37 per cent. of blue light of 4750 Å.U. is transmitted to about 50 m., and the same percentage of light of 4490 Å.U.—the most sensitive region for the cell used by us—to about 82 m.; on the other hand, only 19 per cent. of red light 6000 Å.U. is transmitted by pure sea water to 10 metres, a depth at which we found 33·5 per cent. of blue light for actual sea water 20 miles off shore.

It is thus obvious that the selective absorption of the water, as such, is most noticeable in clear water in which there is absolutely no tint and the grosser particles are much reduced in number save for the plankton organisms themselves. The red end of the spectrum being cut out, the light remaining is largely blue in clear water, so red algæ—which appear black to the eyes of a diver—are obviously efficient absorbers of light; they flourish, therefore, in clear water, where their red pigment is an adaptation that enables them to utilise to advantage the blue light present in reduced amount. In fresh water, however, such clear conditions are rarely encountered, and algæ with red pigment are conspicuous by their absence.

It is true that Paschen has recorded that in Alpine lakes flagellates and Cyanophyceæ with red spotted olive green and, finally, deep red are found at about 10 metres and downward, but there is no general development of algæ with red pigment in fresh water,

simply because at the depth at which the water, as such, would have left light preponderatingly blue, the gross particles would have reduced the illumination to less than that at which plants could survive. The presence of a selectively absorbing tint and of finer particles also reduces the blue light.

Evidence as to the relatively great turbidity of fresh-water lakes is afforded by measurements with the Secchi disc. Southern and Gardiner found that in Lake Atorick, which is supplied by drainage from bogs, the maximum depth for visibility was 3 m., for Lake Derg, 10 miles from the entry of the River Shannon, 4·8 m., for a very clear lake, Loughrea, 10·3 m. Values for certain lowland European lakes range from 0·2 to 7·25 m., according to Thomasson. In the sea, however, off Plymouth, Russell has found 13 m. in April to more than 20 m. in June, and values up to 50 m. are not uncommon in the open sea. Moreover, most of the fresh waters are subjected to periodical floods, with increase in turbidity. Only rarely, therefore, would the possession of a red pigment be of any service to fresh-water plants.

W. R. G. ATKINS.
H. H. POOLE.

Marine Biological Laboratory, Plymouth,
and Royal Dublin Society,
July 8.

The Caryophyllene Alcohols and their Occurrence in Nature.

IT is a well-known fact that most hydrocarbons of the terpene and higher terpene classes are associated in Nature with corresponding alcohols from which the hydrocarbons themselves can be derived by removal of the elements of water. It is very probable, indeed, that these unsaturated hydrocarbons are actually produced in the plant by this method. Now, with the exception of cadinene, caryophyllene is probably the most widely distributed sesquiterpene in Nature, and it has therefore long been a matter of surprise that caryophyllene alcohol (which may readily be prepared from caryophyllene by Wallach's hydration method) does not occur naturally. The author knows of no recorded discovery of this alcohol in essential oils.

A study of the chemistry of caryophyllene, however, and in particular some work carried out recently in this laboratory (Henderson and Robertson, *Jour. Chem. Soc.*, 1926, 62-70), throws considerable light on this problem. Briefly, it has been established that Wallach's hydration method effects ring closure in the caryophyllene molecule with the production of a tricyclic structure. The reaction is not reversible, and the dicyclic caryophyllene structure cannot again be derived from the alcohol and its derivatives. The alcohol and its esters, therefore, possess a different configuration from that of caryophyllene, and hence could not be expected to occur as parent compounds of this hydrocarbon.

This may be said to explain the non occurrence of caryophyllene alcohol in Nature. Another interesting result of this work, however, has recently been brought to my notice. In the paper referred to above, a new caryophyllene alcohol, called caryophyllol, was synthesised directly from the hydrocarbon, and was shown to retain the dicyclic caryophyllene structure. Caryophyllol, therefore, and not Wallach's hydrate, we would expect to find occurring in plants as the natural parent of caryophyllene, and this surmise appears to be justified by some work of Semmler on an oil drawn from clove stems (*Ber.*, 1912, 45, 1392). In the higher boiling fractions he discovered a bicyclic sesquiterpene alcohol the properties of which are practically identical with those of the synthetic caryophyllol, as the following figures show:

	b p.	$d.^{17\cdot20°}$	$_{-}^{17\cdot20°}$	[R_L
Semmler's alcohol from clove stems . .	138-148° at 8 mm.	0·9681	1·50	68·18
Synthetic caryophyllol	142-150° at 10 mm	0·9632	1·5015	68·03

The agreement is the more striking in that the boiling-point and density of these compounds are both lower than is usual with alcohols of this class, and are therefore the more characteristic.

It is hoped that further work will establish the chemical identity of these two alcohols, although the experiments may be complicated owing to the theoretical possibility of four closely related isomers. In the meantime it may with some safety be predicted that caryophyllol will be found to occur in the higher boiling portions of other essential oils which contain caryophyllene.

J. MONTEATH ROBERTSON.

The Chemistry Department,
University of Glasgow,
July 5.

The Reversal of the Hydrogen Series in the Extreme Ultra Violet.

IN the course of the presentation of a paper on the spectrum of neon at the spring meeting of the American Physical Society a year ago, I mentioned that I had been able to obtain the first three members of the hydrogen series in the extreme ultra-violet reversed. Recently I have repeated the experiment with the purpose of improving the technique and confirming the results.

In the first place, it is necessary to produce a continuous spectrum in the region in question; I have already described briefly how this may be accomplished (*Astrophysical Journal*, vol. 60, July 1924, p. 2). The procedure consists in charging a condenser of about 0·5 micro-farad capacity with a direct current and then discharging it through a vacuum tube of the internal capillary type arranged in series with a half-centimetre spark gap. The best results are obtained with a discharge tube of common glass. It is important that the capillary be not too large: I have found a diameter of about a millimetre satisfactory. The material of the electrodes is not important: I have employed tungsten.

The continuous spectrum seems to owe its existence to the disintegration products of the glass set free by the erosive action of the discharge, its strength depends scarcely at all on the nature of the gas in the discharge tube. The experiment is not without mechanical difficulties, for the slit of the spectroscope frequently becomes plugged up by glass dust, the removal of which involves a troublesome process.

Once the conditions for producing the continuous background have been secured, the best results were obtained by admitting hydrogen into the discharge tube at a pressure of about one millimetre. Upon applying the explosive condenser discharge, the first four members of the series—1215·6, 1025·8, 972·5, and 949·7—appear on the photographic plate sharply reversed. It is not necessary to employ pure hydrogen, however; the first two members of the series have been obtained with helium containing a trace of hydrogen. The nature of the apparatus is such (*Astrophysical Journal*, vol. 60, p. 8, 1924) that a distance of about one centimetre separates the end of the capillary from the slit of the spectroscope, while the gas which fills the discharge tube is removed from the light path by a pump the inlet of which lies two

centimetres on the grating side of the slit. The path length available for absorption is thus of the order of three centimetres. It seems certain that a very small quantity of hydrogen is sufficient to produce the reversal of the lines. THEODORE LYMAN.

Jefferson Laboratory,
Harvard University,
June 29.

Plastic Deformation of Single Metallic Crystals.

IN a letter to NATURE (May 22, 1926, p. 720), Messrs. W. E. Millington and F. C. Thompson have proposed a formula for the angle of a uniform wedge formed by the fracture of a single metallic crystal, which purports to be more general than that given by the writer in connexion with the fracture of tungsten single crystals, (*Phil. Mag.*, Aug. and Nov. 1924). By the use of this formula they consider it "possible to extract from the experimental results obtained on these single crystals of tungsten information with regard to the distance through which the atoms move and the number of planes involved which has hitherto remained unrealised."

The writer would like to point out that the use of their formula presupposes a type of slip which is inconsistent with experimental fact and that consequently it is inapplicable as a theory of wedge formation.

They have assumed that slip takes place on two sets of planes equally inclined to the specimen axis, and that the wedge angle depends only on the extent of slip per plane and the distance apart of the slipping planes. It has been shown, however, that a minimum extension of the crystal is required in such a case if fracture is to take place (*Phil. Mag*, pp. 234-235, Aug. 1924), from which it follows that a definite wedge angle (39° approx.) must result if the two halves of the divided crystal are symmetrical; and further, that if a wedge were formed in one half of the crystal with an angle greater than 39°, a wedge having an angle less than 39° must be formed in the other half. Such unlike wedges are not found by experiment; either the wedge angles were both 39° or both were greater than 50°.

The explanation of the 39° wedges is based on a purely geometrical argument and tells us nothing about the extent of slip per plane or the distance apart of the slipping planes other than that on the average they give the theoretical wedge form. The explanation of the large wedge angles given by the writer, although it may not be entirely satisfactory, was at least based on the experimental fact that they were always associated with crystals asymmetrically inclined to the specimen axis—a case which Messrs. Millington and Thompson did not consider.

F. S. GOUCHER.

New York City, June 30.

Use of Pith Dust in Kundt's Tubes.

DURING the summer of 1924, while experimenting at Indiana University with a Kundt's tube, I discovered that the striæ could be most readily observed by using pith dust in the tube. I obtained the pith dust by grinding dry pith from sunflower on a fine-grained emery wheel. By the use of this dust I was able to obtain discs that extended completely across the tube and having the same diameter as the inside of the tube.

These striæ were obtained by the ordinary method used with a Kundt's tube, but for demonstration purposes I found the following to be an excellent way to produce them: Some pith dust was placed in a glass tube of any convenient length and diameter. In one end of the tube a stopper was placed and the open end of the tube was inserted in the open end of a sounding organ pipe. When the tube was inserted the proper distance the striæ formed at regularly spaced intervals and showed the nodes and loops in an excellent way. Discs apparently but one particle in thickness were formed, and when the tube was carefully adjusted with regard to the distance to which it was inserted into the organ pipe, the separate particles remained almost motionless. Often they wove themselves into thin sheets, and when the air was turned off they fell over, maintaining the sheet form.

ROLLA V. COOK.

Bethany College,
W. Va., U.S.A.

The Ancestral Third Claw of a Spider: *Clubiona interjecta.*

THE accompanying photomicrograph (Fig. 1) shows a leg of a young spider of the species *Clubiona interjecta* Koch, before its escape from the egg-cocoon. Adults of the family Clubionidæ possess two tarsal claws, but on the tarsi of the spiderling the median, third, claw is present, demonstrating the fact that the possession of three claws is the ancestral condition. All web-spinning spiders have retained the

FIG. 1.—Leg of young spider, *Clubiona interjecta* Koch.

third claw, while many hunting spiders lose it when very young.

I have referred to this fact in a recent paper on "Evolution in Spiders" (*Science Progress*, Jan. 1926, pp. 475-480), but I believe that this photomicrograph is the only published illustration in support of my statement. For the photography, I am indebted to my friend and colleague, Mr. R. W. Barney.

THEODORE H. SAVORY.

The Biological Laboratory,
Malvern College.

Egyptian History.

HISTORICAL truth compels me to remark that it is inexact to say that the dating by the Egyptians is only "*modern* calculations" (NATURE, June 5, p. 788). All three ancient versions of the lists of kings named by Manetho also state the totals of each of the three great periods; excepting the last, which is not in dispute, only named in one version. These totals count up to Alexander. Where these lists can be checked by external sources they show that overlapping periods of rule were eliminated. It is quite impossible to discuss the details here, but at least the facts justify my statement of the Egyptian reckoning. FLINDERS PETRIE.

The Bose Research Institute, Calcutta.

IN view of the lively interest that has been aroused by the lectures that have been delivered recently by Sir J. C. Bose in London and elsewhere, on the methods and results of his investigations on the physiology of plants, it will no doubt be agreeable to many readers of NATURE to have some general information concerning him and his work, and about the Research Institute which he has founded in Calcutta.

Already a B.A. of the University of Calcutta, possessing a fair knowledge of physics and chemistry, Sir Jagadis Bose came to England in 1880 for the purpose of studying medicine, and entered University College, London, where he made his first acquaintance with biology in the course of instruction given by Sir E. Ray Lankester. However, he soon found that his health, then somewhat precarious, could not stand the strains peculiar to medical study, and decided to go to Cambridge in order to devote himself to natural science. Accordingly he presented himself as a candidate for an open scholarship at Christ's College, to which he was duly elected, and went into residence there in January 1881. At Cambridge he pursued the general course of work for the Natural Sciences Tripos: he studied chemistry, and especially spectroscopy, under Liveing; physics under Lord Rayleigh in the then newly erected Cavendish Laboratory; physiology under Michael Foster; embryology under Francis Balfour; botany under Vines, who was also his college tutor. He took his B.A. degree in 1883: in the meantime he had taken his B.Sc. at the University of London, and ten years later the D.Sc. degree was conferred upon him. He thus acquired a good all-round scientific education, with a special knowledge of physics.

On returning to India in 1884, Sir Jagadis was appointed officiating professor of physics in the Presidency College, Calcutta, on the recommendation of Lord Ripon, the then Viceroy. As the value of his work came to be appreciated, he was soon raised to full professorial rank. This office he continued to hold until 1915, when he retired with the distinction of emeritus professor.

Whilst adequately discharging the onerous duties of his office, Sir Jagadis carried on research as actively as circumstances permitted. He produced a series of papers on electrical subjects which were communicated to the Royal Society by the late Lord Rayleigh, his former teacher, and made his first appearance as a lecturer in England with a discourse on "Electric Waves" at the Royal Institution in 1896, which he soon afterwards repeated in Paris and in Berlin.

At this point came the widening of Sir Jagadis' horizon to include living as well as non-living matter. He incidentally observed, in the course of his researches, that the metallic receivers of the electric waves showed 'fatigue' after prolonged service, and regained their activity after a period of rest; and conversely, that they became inert after too long a rest, but could be revived by an electric shock. He was so struck by the close resemblance of these phenomena to those presented by living muscle and nerve under similar conditions, that he proceeded to make a series of comparative experiments, the results of which were embodied in his book, "Response in the Living and Non-Living" (1902). It is there established beyond doubt that metals (but apparently no other form of non-living matter) possess to a certain degree the 'irritability' which had hitherto been regarded as peculiar to living protoplasm. When a nerve is stimulated, whether electrically, mechanically, or thermally, it gives an electrical response of negative variation. The amplitude of the response can be made to vary by changes in the conditions; it is increased, within limits, by a stronger stimulus, by a rise of temperature, or by treatment with stimulant substances; it is decreased by weakening the stimulus, by lowering the temperature, or by treatment with depressant substances; it can be altogether arrested, either temporarily or permanently, by excessive heat or cold, or by treatment with poisons. All these reactions Sir J. C. Bose obtained with strips of metal. This leads to the remarkable conclusions that 'irritability' is not exclusively the property of living matter: that the 'negative variation' response to stimulation is not a sign of 'life.' Irritability would appear to indicate a certain unstable molecular constitution common to metals and to protoplasm: the negative electric variation, to be the expression of molecular disturbance due to stimulation.

In the book to which reference has been made, the first evidence was given that not only the 'sensitive' plants, as was already known, give this electric response, but also that all plants, and all parts of plants, do so. It was made clear that all plants are sensitive, though only the so-called 'sensitives' are conspicuously motile. The novelty of the idea led Sir Jagadis to devote himself more to the biological than to the physical side in his further investigations; and rather to plants than to animals, because the physiology of animals had advanced much further than that of plants. Progress in the study of the physiology of plants had been hindered by the too mechanical conception of it that had prevailed: it seemed to have been forgotten that both animals and plants consist essentially of protoplasm, and that they must therefore present essentially the same reactions, though modified by special adaptations.

Inspired by this principle, Sir Jagadis proceeded to investigate the irritability and movements of plants by applying the methods that had yielded such fruitful results when applied to animals, and devised apparatus of special sensitiveness for the detection and automatic record of their less vigorous response. His results and conclusions have been published in a series of books, in a number of papers in the *Proceedings*, and in the *Transactions of the Royal Society*, of which he was elected a fellow in 1920; and in the *Transactions of the Bose Research Institute*, of which four volumes have appeared (1918–21).

Without going into too much detail, a few of Sir Jagadis' most striking researches and discoveries may be mentioned. For example, his book "The Physiology of Photosynthesis" (1924) gives the most satisfactory extant account of a process which is of cosmic importance. In his "Physiology of the Ascent of Sap" (1923), he brings forward convincing experimental

evidence that the sap is raised in the tree-trunk by the active contraction of special propulsive cells, the position of which he was able to localise by the electric probe, which he originally devised for the detection of the geo-perceptive layer of cells in stems and roots, a conclusion which is still strongly contested by the adherents of the traditional physical explanation of the process. His most recent book, "The Nervous Mechanism of Plants" (1926), brings together all the evidence scattered throughout previous works that the conduction or transmission of excitatory impulse in plants is a physiological process and is limited to a particular tissue, certain elongated tubular cells of the bast in the vascular bundle, which may justly be termed 'nerve,' in opposition to the current view that the process is purely mechanical and that the tissue concerned is the wood. The conducting tissue in the stem and leaf was located by the electric probe, which again did good service, and the physiological nature of conduction is established by the observation that, in the plant as in the animal nerve, conduction is affected by changes of temperature, by blocking and by stimulating agents, which could not have any such effect upon it were it merely mechanical. A special account is given of the nervous arrangements in the motile leaf of the sensitive *Mimosa pudica*, in which reflex action is demonstrated.

Taking together this book and that on the ascent of sap, it may be generally stated that Sir J. C. Bose's researches have established the existence in the vascular plants, at least, of a circulatory and of a nervous system, using the terms in a loose general way. The 'circulatory system' includes neither heart nor veins, consisting entirely of strands of propulsive cells distributed throughout the plant, representing a contractile arterial system: similarly, in the 'nervous system' there are no central organs, such as brain, spinal cord, or even ganglia, only nerves, of which some have been shown to be sensory, others to be motor. No doubt there remains much yet to be discovered along these various lines of research.

The Research Institute at Calcutta (Fig. 1) was founded and built by Sir J. C. Bose as a place where he and his students and their successors might continue to carry on the researches of which some account has been given above. It was publicly inaugurated on November 30, 1917, and has been in active operation ever since. It is a beautiful and commodious building, standing in its own spacious grounds, with all the details of its construction and arrangements carefully thought out to ensure its perfect adaptation to its purposes. There is a large auditorium capable of accommodating 1500 persons, a library, and rooms and laboratories for work of various kinds. No elementary teaching is undertaken: the only object in view is post-graduate research. The carefully selected scholars, of whom there are at present about sixteen, are admitted on the condition that they devote themselves wholly to the prosecution of research, not as a means of livelihood or for the satisfaction of personal ambition, but, in the words of the founder, "in order to realise an inner call to devote one's whole life to the infinite struggle to win knowledge for its own sake and to see Truth face to face." They receive a modest allowance for their maintenance so that they may be free from distracting cares. The line of research pursued is essentially physiological in its direction, and includes both animal and plant in its scope, though so far the plant has received more

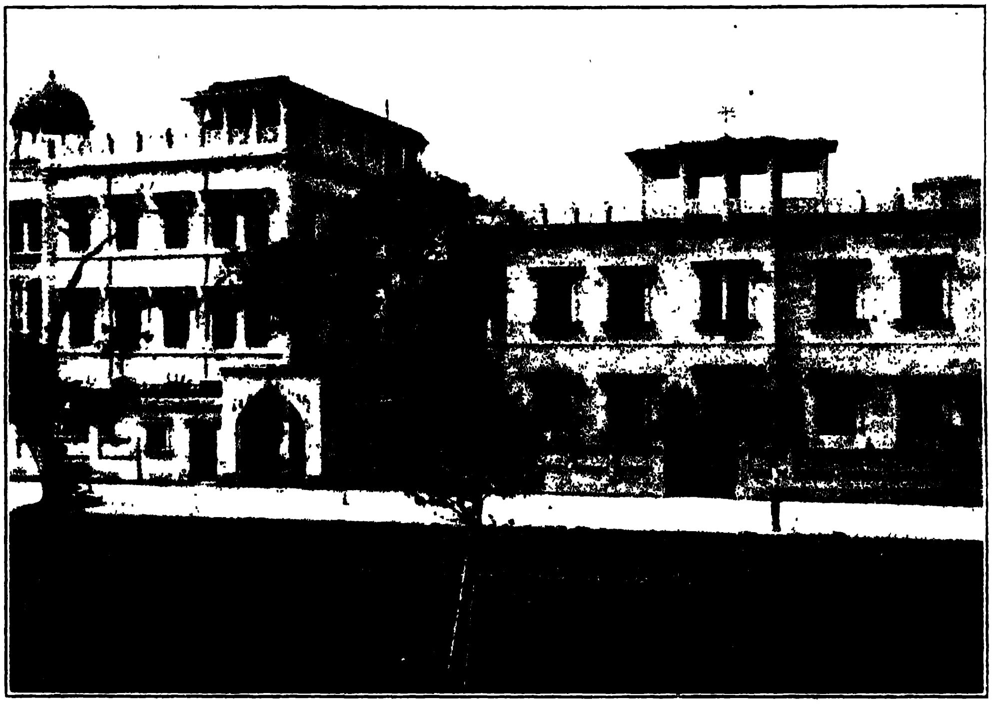

FIG. 1.—The Bose Research Institute, Calcutta.

attention than the animal. But it is physiological in the widest sense, encroaching, as occasion arises, on physics, on bio-chemistry, on botany and zoology, and on histology. At the present time there are no workers at the Institute other than the staff and the scholars, but it is the hope and desire of the founder that it may be frequented by students from all parts of the world, who are assured beforehand of a hearty welcome and of a hospitable reception.

The foundation of the Research Institute in Calcutta, as well as of the branch, Mayapuri, situated at Darjiling at 7000 ft. elevation, in an altogether different climate, was due, in the first instance, to the munificence of Sir J. C. Bose; since then, considerable sums have been contributed by Indian princes and others for extensions and for endowment. The Imperial Government of India has recognised the value of the services rendered by the Institute to the advancement of science by making an annual grant out of public funds for its upkeep. The Institute has continued from the beginning to expand both materially and intellectually. It has shown what important results can be obtained by the combination of the logic and the scientific methods of the West with the imagination and the idealism of the East. Even now it is still only at the beginning of its career, a career, let us hope, of ever-increasing usefulness and brilliance, which ought to be assured by the principles of self-abnegation upon which its constitution is based, more than fulfilling the most sanguine expectations of its founder and reviving the ancient reputation of India as a home of learning.

The Lewis Evans Collection at Oxford.

Recent Additions.

WHEN the oldest of British museums was re-opened for the scientific treasures presented to the University of Oxford by Dr. Lewis Evans, it was foreseen that that fine collection must act as a lodestone and attract cognate objects to itself. This expectation has been realised in a remarkable measure by gifts and loans of apparatus, and by the discovery and reconstruction of long-forgotten instruments. The first fruits of the reversion of a part of the Old Ashmolean building to its original use as a Science Museum are now on exhibition.

Several colleges have contributed apparatus that is second to none for illustrating the early history of many scientific inventions. Both Merton and Oriel Colleges have proved themselves faithful custodians of the quadrants and astrolabes of their astronomer fellows of the fourteenth century. No other educational institution can boast continuous possession of scientific appliances for so many centuries. Contemporary manuscripts written about these very instruments, describing their use, collected when the instruments to which they refer were three centuries old, were given by Ashmole to be "preserved in the presses" of his Science Museum, that his good name might endure "for all time." There they remained for yet another two hundred years, while the instruments, to the use of which they supplied the key, languished in college chests and cupboards. To-day the instruments are on exhibition in Ashmole's building, while Ashmole's own books about them have been put away out of sight in hidden recesses in buildings other than those named in his will. If both books and instruments were once again placed side by side, we should have visible proof of the scientific pre-eminence of the Merton School in the fourteenth century.

To a distinguished fellow of Merton we owe the beginning of our technical scientific literature. Richard, the son of a blacksmith at Wallingford, received a practical education that enabled him in 1326 to compose in terms as clear as those of a proposition of Euclid, a model treatise, the first of its kind known to have been written by an Englishman, upon "How to Make" a scientific instrument. He prescribed the exact dimensions of the metal parts, both in the rough and in the finished state; and he illustrated the shaping and fitting by working diagrams, so that it is possible to interpret his meaning after six hundred years. His distinction as a man of science led to ecclesiastical preferment. Richard, the maker of our first recorded astronomical clock, became abbot of St. Albans. His 'rectangulus,' figured in NATURE for January 12, 1924, has been partly reconstructed this very year in honour of the sixth centenary of his original invention.

Two centuries later the needs of Elizabethan navigators and gunners advanced the skill of the instrument maker to higher levels, both of execution and of invention. By the generosity of the University Court of St. Andrews, there is on view the finest astrolabe known to have been made by an English craftsman. It is 2 feet in diameter, and 33 pounds in weight. It is inscribed with the name of its maker, Humphrey Cole of London, and is dated with the day of the month, May 21, 1575, the very year when he was getting ready the instrumental outfit for Martin Frobisher's first expedition in search of the North-west Passage to Cathay, an enterprise in which Elizabeth herself was financially interested to the extent of 1000*l*. By the finding of Cole's great astrolabe we have proof for the first time that there were in London craftsmen capable of executing work equal in quality to that of the instrumental equipment of the best-endowed observatory in the world, the astronomical observatory of Tycho Brahe at Uraniborg. Nor was this Cole's only claim to a place in our memory. He was the first Englishman to engrave a copperplate map for the illustration of a book, the Bishops' Bible of 1572. The advent of the Lewis Evans collection has also led to the discovery of one of Cole's early theodolites in the Library of St. John's College. This discovery proves him to have been the maker and improver, if not the original designer, of our premier surveying instrument, an invention usually associated with the name of Leonard Digges of University College.

A century later and we come to the epoch of the great experimenters, too soon to be followed by the epoch of the great destroyers. The Royal Society, finely equipped in the days of Daniel Colwall and Grew

with a repository of scientific apparatus that would now have the utmost historical value, has neglected and scattered the instruments of its great alumni, Boyle, Wren, Hooke. A fashion has been set of undervaluing scientific treasures left in trust, the latest examples being the dispersal of the Crisp collection of Microscopes, of the Howard Library (by the Royal Society), and of a part of the Library of Sir Isaac Newton.

The Lewis Evans collection has afforded an opportunity of trying to stem the current of our losses, and by the construction of models illustrating certain aspects of the work of the first Oxford fellows of the Royal Society. Models of Wren's perspectograph and level recall his method of dealing with problems presented by the devastated areas in the Metropolis after the Great Fire of 1666. A model of Hooke's microscope recalls what was perhaps the greatest achievement of that universally inventive genius, the first discovery of cell structure in living beings. In another case is an exhibit illustrating the first discovery of oxygen in 1668 by John Mayow of Wadham College. A model of Boyle's first airpump reminds us that it was the High Street in Oxford that produced the first English engine to demonstrate the possibility of harnessing the force exerted by atmospheric pressure, the "spring of the air," as Boyle called it. Other models show how the dwellers in an inland town have been able to teach and assist navigators: Hooke's reflecting instrument, Gunter's cross-staff and sector, the magnetic compasses of 1269 of Peter Peregrinus, and of 1750 of Gowin Knight of Magdalen College being notable examples, paralleled in our own time by the instruments invented for seamen by Lord Kelvin.

Space will not permit us to rehearse all the exhibits in our small Museum, but in truth we may define it as a school of gratitude to the great men who have increased the knowledge and the power of the human race. The most recent of the reconstructions is a beautifully made astrolabe designed by Prof. Frewen Jenkin, for making known the virtues and uses of that 'mathematical jewel' to a wider public than the favoured few who possess original examples. In this regenerated form, the astrolabe again becomes an instrument of great educational value.

The enterprise of museum founding has not been without its disappointments. First and foremost was the dispersal of the collection formed by Sir Frank Crisp to illustrate the evolution of the microscope. Through the kindness of Sir John Findlay, one of the masterpieces of that collection, a superb silver instrument by Adams, is on view in Oxford for the meeting of the British Association. But the general disappearance of much good apparatus in Oxford itself is deplorable. Only a few months ago there were in existence things of great scientific interest which have vanished. A model with which Bradley illustrated his discovery of the aberration of light is not now forthcoming. Antique microscopes, barometers, the paraphernalia of the educational methods of a century of preparation for the great scientific advances of to-day, have gone to the scrap heap—destroyed in many cases by the urgent needs of research in hand. In the modern laboratory there is no place in which to store the apparatus of bygone experimenters, even if there were a desire to keep it intact, rather than to make use of its parts.

It is our plea that scientific instruments that are of value, either for beauty of design, for achievement in the laboratory or lecture-room, or for some other good cause, should at least be treated with the respect that is accorded to early editions of printed books in a library, or to pictures in a gallery of art. The destruction of a copy of an old book that has been printed in hundreds and reprinted in tens of thousands, inflicts no great harm on the world of letters, but the loss of a unique instrument obscures the whole meaning of early work. Only by contemporary scientific appliances can we hope to show to future generations the ever-varying fashions and phases of our natural philosophy: and few objects are better worth the effort, for in our northern civilisation, natural science has become of greater consequence than art. To traverse the long galleries of the museums of arts and crafts, and to study their masterpieces, is a dispiriting pilgrimage, for it brings home to one how slight is the influence that such exhibitions exercise in elevating the art of a modern people. Scientific instruments, too, show regression in respect of their art: but they show continuous advance in respect of their science.

All work of preservation is of the utmost value in that it helps to check a tendency to destroy evidences of our own early civilisation, and to remind us that with our now diminished resources, instead of spending large sums on the conservation of relics of antiquity abroad, it may pay better to honour the prophets of our own country.

R. T. G.

The Oxford Meeting of the British Association.

MEMBERS of the British Association visiting Oxford during the forthcoming meeting will find themselves in the midst of a south midland district which is, from the naturalist's point of view, possessed of great and varied interest. Opportunities will be given by means of sectional excursions for gaining such acquaintance as may be possible with the geology of the surrounding country, and with noteworthy features of its characteristic fauna and flora. It is obvious that no extended study of the district can be undertaken in the short time at the disposal of those attending the meeting, but the "Handbook" which will be distributed to all visiting members of the Association will provide them with a summary, under various heads, of what the neighbourhood of Oxford can show in the way of natural features of interest.

This handbook, the work of several authors, each of them a first-rate authority on the subject with which he deals, is being produced under the editorship of Commander J. J. Walker, R.N., and will no doubt take rank as a volume of permanent value. It begins with an account by Mr. H. O. Beckit, director of the School of Geography, of the physiography of the Oxford region, including a definition of its boundaries, and describing its land forms and physical history. Sections are added by Mr. W. G. Kendrew on its climate, by

Mr. E. T. Leeds on its early and by Mr. H. O. Beckit on its modern settlement. The geology of the area is dealt with by Prof. W. J. Sollas, who devotes his attention mainly to the parts of the great Jurassic system which lie within easy reach of Oxford. Dr. K. S. Sandford contributes an account of superficial deposits, and Mr. A. J. Arkell an appendix on the Corallian Period. Articles follow on the botany, ornithology and entomology of the Oxford country; these have been treated with great thoroughness by Dr. G. Claridge Druce, the Rev. F. C. R. Jourdain, and Commander J. J. Walker respectively; the latter having as collaborators Messrs. W. J. Lucas, A. H. Hamm, E. G. R. Waters, and J. Collins. The spiders have been attended to by Mr. A. W. Pickard-Cambridge, and the land and fresh-water mollusca by the Rev. L. W. Grensted. Among the institutions for which Oxford is famous there are three of special importance for the members of the British Association. The first of these, the great entomological department, which takes its name from the late F. W. Hope, is described by Prof. E. B. Poulton; the Pitt-Rivers Museum of Ethnology is treated of by its curator, Mr. Henry Balfour; and the whole series of these valuable memoirs is wound up by Dr. R. T. Gunther's account of the Old Ashmolean Museum and the Lewis Evans collection of scientific instruments therein housed under his curatorship.

The general excursions to Swindon, Stratford-on-Avon, Warwick and Kenilworth, Burford, Fairford and the Cotswolds, Blenheim Palace, and the expeditions by river to Day's Lock, to Abington and to Reading, all have their own objects of interest; but for the special purposes of the naturalist the sectional visits to Fawler, Hanborough and Stonesfield; Kirtlington; Culham, Abingdon and Radley; Aylesbury and Wheatley; Swindon, Faringdon, etc.; Boar's Hill; Shotover and Headington (geology); Tring (zoology); and Swinford Bridge; the Berkshire Downs; Lord Parmoor's beechwoods; Bagley Wood (botany and forestry), will provide the best opportunities for studying the natural features of the district.

Apart from the excursions and exhibits which appeal more directly to the geologist and biologist, there is much in Oxford to engage the attention of visiting members. A special selection of rare and interesting works will be on view in the Bodleian Library, by the courtesy of the librarian; and a similar courtesy will be shown by the authorities of the Radcliffe Library now housed at the Museum. Special visits to colleges have been arranged, each under the direction of a guide competent to explain the historical and architectural interest of these institutions, which are such distinctive constituents of the older Universities. The Lewis Evans collection of historic scientific instruments will be shown and discoursed on by the curator; the Pitt-Rivers ethnological collection will be open to inspection, and a visit will be undertaken to the printing works of the famous Clarendon Press. Not the least popular amongst other attractions will be a demonstration on Port Meadow by the Royal Air Force. Machines of several types, with instruments and other apparatus of special interest, will be parked for inspection; a flying display will take place, and the machines will be seen to leave park and take off by flight for return to their home aerodromes.

Much interest will naturally centre round the University Museum, the early history of which structure has been graphically related by Dr. and Mrs. Vernon in an excellent little book published soon after the jubilee celebration held on October 8, 1908. To those whose recollections go back to the days when Acland and Ruskin were prominent figures in the University, the main building of the Museum is eloquent of the generous ideals of those distinguished enthusiasts. Nor should it be forgotten that without the support of Pusey and his Tractarian friends the scheme for giving the natural sciences a worthy home in the University might have been indefinitely delayed. It is true that the ideal proposed to himself by Acland, that of ensuring that every one leaving Oxford with a degree should at least have had given to him "a general view of the planet on which he lives, of its constituent parts, and of the relations which it occupies as a world among worlds," has never been realised; the growing necessity for specialisation, together with other reasons, forbade its accomplishment. But the tree planted with so much hope by Acland, Daubeny and Buckland has borne good fruit, though of a kind scarcely contemplated by its original cultivators. Of late years opposition to the growth of the Museum and its departments has usually taken the form of protest against encroachments on the open space of the University park. But a delimitation of frontier has at last been established by general agreement, and the question may now be taken as settled for very many years to come. On the present occasion the Sections of Mathematics and Physics, Geology, Zoology and Engineering, will be housed in the Museum and its annexes, while Botany will find an appropriate home in the neighbourhood of the venerable "Physic Garden." F. A. D.

DISTINGUISHED GUESTS FROM ABROAD.

Usually a number of eminent scientific workers from countries outside the British Empire are invited to be guests of the Association at its annual meeting. We print below some particulars of those who have accepted invitations for the Oxford meeting.

Prof. GEORGE DAVID BIRKHOFF, who has occupied the chair of mathematics in Harvard University since 1919, was born at Overisal, Michigan, in 1884. He early engaged in teaching mathematics in the University of Wisconsin; next at Princeton, until 1912, when he became an assistant professor at Harvard, taking up later the major post. President, in 1925, of the American Mathematical Society, he has been editor of its *Transactions* since 1920. He is a member of the National Academy of Sciences, Washington. In 1918 Prof. Birkhoff was awarded the Querini-Stampalia prize of the Royal Institute of Science and Arts, Venice, for researches in dynamics. He is the author of "Relativity and Modern Physics" (1923).

Dr. MAX BORN, professor of theoretical physics in the University of Gottingen, is one of the chief exponents of the conceptions of modern physics. A recent work of his, "Vorlesungen über Atommechanik" (1925), has received wide attention and appreciation, and an English translation is in course of preparation.

The ABBÉ BREUIL, D.Litt. (Cambridge), is chief pro-

fessor at the Institute of Human Palæontology, Paris, the foundation of the late Prince Albert of Monaco. He is the foremost authority on the art and technique of the palæolithic epoch. Prof. Breuil has collaborated in many important works on prehistoric art, and in general archæology, with MM. Capitan and Peyrony. One of the most illuminating and suggestive of his memoirs (1905) is "La Dégénérescence de Figures d'Animaux en Motifs Ornementaux à l'Époque du Renne." Prof. Breuil made lately a tour through Central Europe, Poland, and Hungary, accounts of which have appeared in *L'Anthropologie.*

Prof. DOUGLAS HOUGHTON CAMPBELL, botanist, was born at Detroit, U.S.A., in 1859. He is a foreign member of the Linnean Society, and a member of the National Academy of Sciences, Washington. Professor of botany in the University of Indiana from 1888 until 1891, he has since then occupied a similar chair in the Leland Stanford University, California. Prof. Campbell is the author of several botanical text-books.

Prof. CONSTANTIN CARATHÉODORY, University of Munich, mathematician, was born in 1873. Originally professor of mathematics in the Technical Institute, Hanover, next at Breslau, he afterwards successively occupied professorial chairs in the Universities of Göttingen, Berlin, Smyrna, and Athens. He is Ph.D. Göttingen.

M. MAURICE CAULLERY, who was born in 1868, has been professor of zoology at the Sorbonne, Paris, since 1909; formerly he occupied a similar chair in the University of Marseilles. He is director at the Sorbonne of the Laboratoire d'Évolution des êtres organisés et embryologie générale. A publicist of note, he has written on the universities of the United States, and connected scientific life. Prof. Caullery is a foreign member of the Linnean Society of London.

Prof. FRANK WIGGLESWORTH CLARKE, chemist, was born at Boston, U.S.A., in 1847. He was professor of chemistry in Harvard University, 1873–74; afterwards, down to 1883, he held the chair of chemistry and physics in the University of Cincinnati. From that date Prof. Clarke has been Chief Chemist to the United States Geological Survey, and Honorary Curator of Minerals, United States National Museum. A Chevalier of the Legion of Honour, he is a foreign member of the Geological Society of London, LL.D. Aberdeen, and D.Sc. Manchester. In 1903 the Literary and Philosophical Society of Manchester awarded him its Wilde medal. Prof. Clarke is the author of many papers on geo-chemistry in the U.S. Geological Survey's publications.

Prof. EDWIN GRANT CONKLIN, biologist, was born at Waldo, Ohio, in 1863. He graduated at Ohio Wesleyan University, and was (1891–94) professor of biology there. Since 1908 he has occupied the chair of zoology in the University of Princeton. He is a member of the National Academy of Sciences, Washington. Prof. Conklin is the author of "Heredity and Environment," "Biology and Democracy," and other works.

M. PIERRE DANGEARD is professor of botany at the Sorbonne, Paris, and director of the Botanical Laboratory there. He is a member of the Academy of Sciences, Paris, and an Officer of the Legion of Honour. Prof. Dangeard has been responsible, during many years, for an ever-constant series of memoirs and observations in general botany.

Dr. WALTHER VON DYCK, rector of the Bayerische Technische Hochschule, Munich, is also professor of mathematics in the Institute. He is the author of numerous papers on analysis, differential equations, and the theory of functions, and has interested himself in the work of the German Museum at Munich.

Prof. PAUL EHRENFEST, born in 1880 at Vienna, has been, since 1912, professor of theoretical physics in the University of Leyden. He holds a high position in the ranks of mathematical physicists, and has published many valuable memoirs, particularly ou spectra in relation to atomic structure. He is Ph.D. Vienna.

Prof. JAMES FRANCK, occupant of the chair of physics in the University of Göttingen, and director of the Physical Laboratory there, is the author of many memoirs of distinction on the atomic theory and its issues. He has collaborated with Dr. Max Born in some of these contributions in the *Zeitschrift für Physik.*

Prof. OTTO JAEKAL, Ph.D. Munich, occupant of the chair of geology and palæontology in the University of Greifswald, was born in 1863. He is well known in English geological circles, and recently was elected a Foreign Associate of the Geological Society of London. Formerly on the teaching staff of the University of Strassburg, he was afterwards curator of the Geological and Palæontological Museum, Berlin. Prof. Jaekal long rendered signal service as editor of the *Palaeontologische Zeitschrift.*

Prof. ARTHUR EDWIN KENNELLY, who has occupied the chair of electrical engineering in Harvard University since 1902, was born at Bombay in 1861. Educated at University College School, London, he early trained for service with the Eastern Telegraph Company and was engaged on cable-repairing work in many seas; also at one time he was engineer in charge of submarine cable laying for the Mexican Government. Prof. Kennelly was principal electrical assistant to Mr. T. A. Edison from 1887 until 1892. He is a Chevalier of the Legion of Honour, an honorary member of the Institution of Electrical Engineers, London, and a member of the National Academy of Sciences, Washington.

Prof. HENRY FAIRFIELD OSBORN, president of the American Museum of Natural History, was born at Fairfield, Connecticut, in 1857. He graduated at Princeton University, U.S.A. Early in his career he studied at Cambridge under F. M. Balfour, and for some time under Huxley, at the Royal School of Mines, London. Prof. Osborn was this year awarded the Wollaston medal of the Geological Society, when reference was made to his long record of researches on the palæontology of vertebrates. Important publications of his include "The Age of Mammals in Europe, Asia, and North America," and "Men of the Old Stone Age." Prof. Osborn is a foreign member of the Royal Society of London, and a Darwin medallist.

Prof. CARL RUNGE, of Göttingen, was born in 1856. Originally one of the professors at the Technical Institute, Hanover, he was appointed (1904) to the chair of applied mathematics in the University of Göttingen. He is eminent for his classical researches in spectroscopy. In 1909–10, Prof. Runge was at Columbia University, New York, as interchange lecturer.

Prof. G. MANNE SIEGBAHN, who has held the chair of physics in the University of Upsala since 1923, was born in 1886. Formerly he was a professor in the University of Lund. Nobel laureate in physics for 1924, an experimentalist of great refinement of method, his chief researches have been in the field of X-ray spectroscopy. He has made a special study of the soft radiations which lie between the ultra-violet and the ordinary X-ray region. Prof. Siegbahn is the author of "The Spectroscopy of X-rays" (Oxford Press, 1925). Published originally (1923) at Berlin, it was translated by Mr. George A. Lindsay, assistant professor of physics in the University of Michigan.

Prof. FRANK LINCOLN STEVENS, botanist, was born at Syracuse, N.Y., in 1871. He studied at Ohio State University and the University of Chicago. He occupied the chair of botany and vegetable pathology in North Carolina College of Agriculture and Mechanical Arts from 1902 until 1912, and shortly afterwards was elected professor of plant pathology in the University of Illinois, a post he still fills. He has been for many years head of the department of plant diseases and biologist in North Carolina Agricultural Experimental Station. Prof. Stevens is the author of a standard work, "Plant Disease Fungi."

Dr. JOHANNES WALTHER, who was born in 1860, occupies the chair of geology in the University of Halle-Wittenberg, Halle. Formerly he held a similar chair in the University of Jena. Dr. Walther is a foreign member of the Geological Society of London.

Prof. HENRY BALDWIN WARD, zoologist, was born at Troy, N.Y., in 1865. He is a graduate of Williams College, U.S.A., and he was a post-graduate student at the Universities of Göttingen, Freiburg, and Leipzig. He was professor of zoology in the University of Michigan from 1899 until 1909, and has since that date occupied the chair of zoology in the University of Illinois. He has long been in charge of the biological work of the Michigan Fish Commission on Lake Michigan, and has rendered good service to the United States Fish Commission. Prof. Ward is the author of "Freshwater Biology" (1917), and of many monographs and papers, especially in regard to animal parasites and the relations of animals to disease.

Geheimrat WILHELM WIEN, the distinguished physicist, rector of the University of Munich, was born in 1864. Formerly he was professor of physics in the University of Würzburg, having succeeded Röntgen in 1900. Whilst working there, Prof. Wien was awarded the Nobel prize for physics (1911); in that year Madame Curie was given the Nobel prize for chemistry. Prof. Wien accepted the chair of experimental physics at Munich, on leaving Würzburg. It may be recalled that at the meeting of the Association held in Cambridge in 1904, Prof. Wien attended and read a paper entitled "Experiments to decide whether the Ether moves with the Earth."

Prof. PIETER ZEEMAN, of Amsterdam, was born in 1865. He is a foreign member of the Royal Society of London, and in 1922 was awarded the Rumford medal for his researches in optics. Earlier (1902) Prof. Zeeman was Nobel laureate in physics, jointly with Prof. H. A. Lorentz.

Limitations of space do not allow extension of the above brief notices, but we may add that other prominent European men of science attending the meeting include M. von Frey, professor of psychology, University of Würzburg, Dr. D. Nys A. Michotte, professor of psychology in the University of Louvain, Prof. E. Rignano, Milan, Prof. H. Kniep, occupant of the chair of botany in the University of Berlin, Dr. Bosch Gimpera, University of Barcelona, the leading archæologist of northern Spain, M. Champy, professor of histology in the University of Paris, Dr. J. A. Christiansen, professor of chemistry in the University of Copenhagen, and Prof. H. ter Meulen, of Delft.

Obituary.

SIR PETER SCOTT LANG.

WE learn with regret that Sir Peter Redford Scott Lang died on July 5 at his residence at Mansefield, St. Andrews. Owing to failing health, in 1921 he had retired from the chair of Regius professor of mathematics in the United College at the University of St. Andrews, being given the title of emeritus professor, while he ever continued to show an alert and sympathetic interest in the town and college which he loved and served.

Born in Edinburgh on October 8, 1850, Sir Peter received his early education at the Institution and then studied at the University there, where he performed brilliantly in spite of the interruptions to his college work caused by the need to spend considerable time in an office. As a student so circumstanced and yet so successfully overcoming the difficulties of his twofold task, he won first the notice and later the esteem and lasting friendship of the late Prof. P. G. Tait, who appointed him in 1872 to be his assistant in natural philosophy at the University of Edinburgh.

In those days the graduate in arts was seldom proficient or even interested in the sciences; and it was notable how this youthful assistant soon acquired a wide and accurate knowledge of these fields, inspired as he was by the example of Prof. Tait. These two friends co-operated both in classroom and in the work of the Royal Society of Edinburgh, where under this guidance the younger man received much useful experience, and where in 1878 he was made a fellow.

The next year Sir Peter was called to the chair of mathematics in St. Andrews, which had just been vacated by Chrystal, who was migrating to Edinburgh. From 1879 until 1921 Scott Lang held this post with marked distinction. He devoted himself both to his teaching and also to the wider interests of college life. In this venerable University, affiliated indeed to Bologna, the oldest of medieval universities, new life was wanting. Chrystal had scarcely spent long enough time there to make his influence felt; but during the service of his successor a regeneration took place. He sought to regain that spirit of comradeship among the students which was lacking, and, thanks very largely to his unsparing energies, St. Andrews regained much of the charm and distinction which are the incidental gifts that one of the older universities bestows on its

students. He earned the honours which King and College gave to him at the close of his active career.

Miss Gertrude Lowthian Bell.

Archæological studies in the Near East have suffered a great, indeed an almost irreparable, loss by the death of Miss Gertrude Lowthian Bell, which took place at Baghdad on July 11, at the age of fifty-seven years. The eldest daughter of Sir Hugh Bell, she was educated at Queen's College, London, and at the University of Oxford, where she took a first class in the History Schools. She then went to Teheran and later began her travels in Arab countries, travels in which—a remarkable achievement for a woman—she crossed the deserts of Arabia, thereby winning for herself the gold medal of the Royal Geographical Society, and visited the Shammar stronghold at Hayil, to which no European had penetrated for twenty years. Here a detention, virtually as a prisoner, gave her a remarkable insight into Arab customs, the Arab temperament, and an acquaintance with Ibn Saud, which were to prove later of the greatest value to Great Britain. It was very largely this knowledge of Arab character which was responsible for her successful achievement as a political officer at Baghdad during the War in the Political Department of the Government of India, which was then in charge of Mesopotamian affairs.

Miss Bell was not interested in geographical exploration alone; her knowledge of eastern archæology was both wide and deep. She was particularly interested in the study of early Christian and Islamic architecture, and in 1905 and 1907 she was associated with Sir William Ramsay in an examination of the churches of Lycaonia. The results were published in "The Thousand and One Churches," of which she wrote the greater part. Perhaps her greatest service to archæology was after the War, when she had taken up her residence as a member of the Government service in Baghdad. It was largely through her efforts that excavations were so promptly resumed after the War by the British Museum at Ur and the University of Oxford at Kish, and she founded and organised the Museum of Antiquities at Iraq, in which she worked hard as a labour of love until the time of her death.

Miss Bell's knowledge of the Arab and Arab politics played a large part in the settlement of Iraq after the War. How great this knowledge was, and the qualities upon which it was based, may perhaps best be gathered by those who did not know her personally from her books. In "The Desert and the Sown" (1906) and "Amurath to Amurath" (1910) she revealed the indomitable courage, backed as it was by an iron constitution, which had enabled her to endure the hardships of the desert; but she also showed what were her most striking qualities—penetration, sympathy, and a wide knowledge of Eastern human nature, permeated with a humorous and tolerant appreciation of its foibles.

Mr. F. Harrison Glew, M.B.E.

We regret to record the death of Mr. F. H. Glew, M.B.E., which took place on July 10, at the age of sixty-eight years. Mr. Glew was educated at Wakefield Grammar School and entered engineering works in that town, but soon changed over to pharmaceutical studies and, in due course, became a member of the Pharmaceutical Society. Soon after the discovery of X-rays he became one of the pioneers of their use in medical work in England, and, for many years, he did the X-ray work for the Lambeth Infirmary, for the Belgrave Hospital for Children, and for medical men in that district.

As a pharmacist, Mr. Glew's interest was aroused by the medical uses of radium, and he occupied an important position in the radium world for many years, where his manipulative skill and chemical knowledge were put to very severe tests. During the War he was chief adviser on radium technique to the Ministry of (Optical) Munitions, his services being rewarded by an M.B.E. When the War was over, a large quantity of radium was put at the disposal of the Medical Research Council for medical investigations, and here again the services of Mr. Glew were requisitioned to deal with the technical problems involved in its use.

Mr. Glew was one of the original members of the Röntgen Society, and contributed several papers to its proceedings, but he wrote little beyond these articles and parts of the section on radiology and radium in the "Extra Pharmacopœia." He was also a fellow of the Institute of Physics and member of the Physical Society, and he served on the Board of Visitors of the Royal Institution, at all of which he gave not infrequent demonstrations. By these demonstrations, always exhibiting something novel in an ingenious way, Mr. Glew became known to a very wide scientific public; he had indeed made for himself a unique place in scientific work. His loss will be felt very much, especially by those who had learnt to look upon him with something akin to affection.

S. Russ.

We regret to announce the following deaths:

Mr. E. T. Cresson, founder of the Entomological Society of Philadelphia, later the American Entomological Society, and an authority on North American Hymenoptera, on April 19, aged eighty-seven years.

Mr G. A. Keartland, for more than forty years a member and in 1907 president of the Field Naturalists' Club of Victoria, who took part as naturalist in several expeditions to Central Australia, notably the Horn Expedition of 1894, and was known for his interest in bird-life.

Prof. Geo. D. Shepardson, professor of electrical engineering in the University of Minnesota since 1892, distinguished for his work on problems of electric lighting and telephone disturbances, on May 26, aged sixty-one years.

Prof J. C. Smock, assistant in charge of the New York State Museum and afterwards (1890–1900) State geologist of New Jersey, on April 21, aged eighty-three years.

Dr. Henry M. Whelpley, dean of the St. Louis College of Pharmacy, secretary of the United States Pharmacopœial Convention and formerly president of the American Pharmaceutical Association, on June 26, aged sixty-five years.

News and Views.

IN his speech at the opening of the exhibition of British chemical plant, held last week at the Central Hall, Westminster, in connexion with the Society of Chemical Industry's Congress of Chemists, Sir Max Muspratt referred to the ever-changing nature of the chemical industry and to the great part which chemical engineering plays in the changes. The life of the Le Blanc soda process, now extinct, was greatly prolonged by engineering, and it is that branch of the industry to which we must look to keep us abreast of the times, and more particularly in regard to the artificial fibre industry and to what is known as 'high-pressure' chemistry. As an illustration of the radical changes now taking place, Sir Max referred to a large sulphuric acid works, using the lead-chamber process, which is producing 1000-1200 tons of acid per week solely by electric power. We must learn to dispense with coal, he said. British chemical industry was built upon cheap coal and the German industry upon dear coal; now the positions are reversed, and all our old problems must be attacked from this new point of view.

THE exhibition, which was organised by the British Chemical Plant Manufacturers' Association, may be described as small but good. Owing to the restricted dimensions of the hall, it was impossible to show any large plant, but the exhibits of plant parts, constructional materials, and accessories, were so numerous and so well selected, that they presented a convincing picture of the resourcefulness and constructive ability of British plant manufacturers. From careful inquiries we have made, we can endorse the claim that at the present time practically all the requirements of British chemical manufacturers can be met at home; in a few respects, such as plant for high-pressure work, it may be necessary to go abroad, but we are gradually accumulating our own experiences in this direction and can look forward to complete independence of foreign makers within a comparatively short time.

AMONG the novelties exhibited was the Webb colloid mill, which consists of a spherical shell with three arms or beaters, circular in section and revolving at different speeds. The emulsified material is withdrawn in such a way that only the extremely finely divided material is removed. Another exhibit of a similar kind was a copper-lined machine for breaking down cotton linters in the manufacture of acetylcellulose silk. Excellent centrifugal machines, such as are used in the home beet-sugar industry, were shown, together with a clutch-pulley which enables the cage-motor to start against full-load torque. The Ruths steam-accumular was too large to be shown *en bloc*, but illustrations and plant parts testified to the value of this type of plant for eliminating the peak-load on boiler-plants, especially in works where large quantities of low-pressure steam are required in process work; the boiler can be worked for the average demand, and the pressure, as well as the temperature, of the steam can be maintained at uniform levels. A 300-gallon aluminium still formed an attractive exhibit, and other interesting exhibits included heat-exchangers, crushing machines, compressors of various types, mixers, electrolytic cells, filters, evaporators, film-dryers, scrubbers, and excellent enamelled cast-iron ware. Constructional materials were shown in abundance, non-corroding metals and alloys being particularly conspicuous. Acid-resisting, long-fibred asbestos from the Transvaal, silica-ware, and 'Prodorite,' the new pitch-cement, were among the more noticeable non-metallic resistant materials. No fewer than forty firms were represented at the exhibition, which left a most favourable impression of the quality and diversity of British chemical plant.

ALL interested in technology from whatever point of view will welcome the news that Italy has fallen into line with others of the leading countries of the world, and has commenced the printing *in extenso* and in separate numbers of the specifications of patented inventions. All patents granted after October 1 of last year are, we understand, to come under the new regulation, but it may be hoped that perhaps some day the earlier period will be similarly dealt with so that the record may be complete. The gap is not so large. The old Kingdom of Sardinia printed the specifications and drawings of patents granted under the basic law of 1855 in a publication entitled *Descrizione delle macchine*, which appeared in semi-annual volumes until 1864, when it was replaced by the *Bollettino Industriale del Regno d' Italia*, which continued except for a short period until 1806. Since the latter year, however, those concerned have had to be content with classified lists of inventions from which only the meagre information supplied by the bare titles is obtainable. The new regime is to be congratulated on the revival of the original practice in the more modern style adopted by so many patent offices. Belgium, Spain, and Portugal are the chief European countries that still have to take this step.

AN unofficial committee of twelve members of various points of view, and no doubt of divergent opinions, on economic problems, has drawn up a report which, under the title of "The Facts of Industry," has been published by Messrs. Macmillan and Co. Ltd., (price 1s.). The committee included among others Lord Astor, Prof. Bowley, Mr. W. L. Hichens, Mr. W. T. Layton, Mr. Kenneth Lee, Mr. B. Seebohm Rowntree, Mr. F. Hodges, Mr. A. Pugh, Mr. J. T. Brownlie, and Mr. J. J. Mallon. In other words, it represented employers, employees, professional economists, and trade union officials. The purpose of the committee was to investigate the possibilities of increased statistical publicity, and to ascertain what statistical information is required and how it can be obtained. The committee, agreeing that it is impossible to formulate a wise policy in industrial problems without knowing the facts of the case, has drawn up a series of recommendations, not with the aim of introducing changes in industrial relations, but in the hope of obtaining an adequate basis of facts

on which to discuss any problem that may arise. In problems of industrial relations, information additional to that which is already available should be collected on total production, cost of material and cost of labour. For the study of industrial fluctuations, figures should be provided by each industry as regards stocks, deliveries, and orders on hand. From the point of view of the investor a number of recommendations are also made. The pamphlet indicates reforms which are outside the scope of political controversy, many that have already been put into effect in the United States and none that could fail to throw light on the difficult problems of the day.

DURING the last twenty years the electric pressures used for testing the material and apparatus used by electricians have been steadily rising. Owing to the much wider areas over which power is transmitted, and the greatly increased demand for it, economical considerations make it necessary to increase the pressure. The pressure required in the test room has to be at least double the working pressure. This necessitates the use of very large transformers which need to be housed in special laboratories. A paper on high voltage laboratories by Mr. A. P. M. Fleming, which has appeared in *World Power* for July, is therefore a timely one. Mr. Fleming points out that in order to keep ahead of developments it is necessary that facilities for producing a million volts should be provided. Several million-volt transformers are in daily use in the United States and on the Continent At the National Physical Laboratory the high-pressure laboratory has been built but the apparatus has not yet been constructed. The Soviet Government at Moscow has similar plant under consideration. With these high-pressure transformers, it is very difficult to avoid producing brush discharges and this renders the measurement of the applied pressure very difficult Mr. Fleming points out that the sphere-gap method of measurement is the one that is almost universally used. In our opinion the radiations from brush discharges must seriously affect the pressure at which the disruptive discharge ensues and so must make the readings very uncertain. It is scarcely fair to say that the method is dependent on purely empirical data. One of the data is the value of the maximum potential gradient between the spherical electrodes and the other is purely experimental. The first is computed by advanced theory, the second is got from concordant experimental results obtained in almost every laboratory in the world. For many tests, high voltage direct current is necessary. This is readily obtained by rectifying high voltage alternating current by a thermionic valve rectifier.

THE First Report of the commission appointed to further the study of solar and terrestrial relationships (Étienne Chiron: Paris, 1926), has recently been circulated by the International Research Council, setting out the statements and recommendations made by the committee which met in Brussels last July. Statements are given (1) of the principal terrestrial phenomena definitely known to be affected by intrinsic changes in the state of the sun or by the sun's rotation, such as (*a*) the magnetic state of the earth and earth currents; (*b*) auroræ; (*c*) meteorological and climatic changes; (2) terrestrial phenomena not improbably affected by solar changes but requiring further investigation to establish a definite relationship, such as (*d*) atmospheric electricity (potential gradient and general ionisation of the atmosphere); (*e*) radio-telegraphic transmission; and (3) terrestrial phenomena likely to be affected by solar changes and therefore requiring investigation from this point of view, such as (*f*) the amount of ozone in the upper air; (*g*) the extra-polar auroral light; (*h*) high-level atmospheric absorption; (*i*) penetrating radiation in the atmosphere; (*j*) the light of the night sky. The recommendations of the committee are then given, indicating clearly the particular matters requiring research and co-operation in observation. Memoranda contributed by members of the committee (C. G. Abbot, G. Abetti, S. Chapman, C. Chree, H. Deslandres, G. Ferrié, G. C. Simpson, C. E. St. John, and C. Størmer) and by a few other investigators make an admirable commentary on the foregoing recommendations. The report concludes with a comprehensive summary of literature up to 1924 dealing with the relations of solar and meteorological phenomena. A French version of the complete report is appended.

ABOUT eighteen years ago, Lippmann indicated the possibility of the preparation of a photographic plate that should contain in itself the image-forming elements, and by a single exposure, etc., give a result that would show a picture of the original in stereoscopic relief, adopting the principle of an insect's multiple eye, and Dr. E. Estanave shortly afterwards deposited a sealed communication with the Paris Academy. Dr. Estanave has only recently been able to demonstrate experimentally the possibility of the process, and he describes his method in *La Nature* of June 26, p. 409. The attempt to make it commercially practical by moulding the glass plate so that it shall have one side covered with small, regularly placed, spherically curved projections the principal focal points of which lie on the other surface, which is coated with a fine-grain gelatine emulsion, appears to have failed because the small lenses so obtained were not good enough. The demonstration that the principle is correct was done by making a block of closely packed Stanhope lenses of about 6 mm. focal length each with a square base of about 2 mm. × 2 mm. A photographic plate was placed with its film side in contact with the surface made by the bases of these small lenses, the exposure made and developed, etc., and the plate then attached to the block of lenses exactly in its original position. The composite plate is viewed by looking through it (as a transparency) with the lens surface towards the eyes. The picture of the original object is then seen in stereoscopic relief.

A REPORT issued by the Smithsonian Institution states that news has been received from Dr. Matthew

W. Sterling that the expedition to New Guinea of which he is the leader has started up the Memberamo River. This expedition, which is a joint undertaking of the United States and the Dutch East India Government, is very completely equipped, and has with it an aeroplane for scouting, exploration and cartography. Including carriers and Indonesian troops, the expedition numbers nearly four hundred individuals. Its purpose is the exploration and mapping of the country which lies between the coast line and the range of mountains which forms the backbone of Dutch New Guinea. The members of the expedition are Dr. Sterling, leader and anthropologist, R. H. Peck, photographer, Hans R. Hoyte, chief pilot, A. E. Hamer, assistant photographer and mechanic, S. A. Hadberg, historian of the expedition. Dr. Van Leeuwen, botanist, and M. Leroux, cartographer and surveyor. It is hoped to secure an extensive collection of bird skins in addition to the scientific data for which provision is made in the personnel of the expedition. A special effort will be made to obtain information concerning the pygmy people of the forests on the mountain slopes, of whom comparatively little is known. It is possible that unknown peoples may be discovered in the interior, of whom the existence is at present only suspected.

BEFORE the War the wood-distillation industry in what is now the eastern part of Czechoslovakia was in a very flourishing condition on account of the abundant supplies of beech-wood But the industry has received a severe set-back on account of the rapid development of improved industrial processes for producing both acetic acid and methyl alcohol synthetically. Acetic acid is now manufactured from acetylene by oxidation with oxygen in the presence of vanadium pentoxide and mercuric sulphate as catalysts. More recently methyl alcohol has been made from water-gas, and it is stated in the *Chemiker Zeitung* that the new process may ultimately lead to the abandonment of the older process, although the synthetic product is much less suitable than wood-spirit for the denaturation of fermented spirit The success of the method depends upon the careful control of external conditions, namely, temperature, pressure, nature of the catalyst, and the relative masses of the reacting gases, since methane, carbon dioxide, and water may be obtained as by-products if conditions are not well adjusted. The water-gas needs to be carefully freed from certain impurities, particularly from sulphur compounds.

UNDER the rather curious title of *The Cancer Review*, the British Empire Cancer Campaign has begun to issue a journal of abstracts of the voluminous literature of cancer in its various aspects. The mass of matter printed on the subject of malignant disease is so great and its quality so varied that some such critical collation is most desirable, and we do not doubt that the present journal will be useful. We hope, however, that it will be possible to arrange and group the material more effectively and to supplement the arid abstracts with the critical surveys which may more properly be called 'reviews,' and in these connexions we would commend the admirable *Tropical Diseases Bulletin* to the consideration of Dr. Francis Cavers and his editorial committee. The form is not so good as the substance: it is printed on heavy art paper (illustrations may be contemplated, but there are none in this first issue), and the line is too long (4⅝ inches) for convenient rapid reading—a point on which publishers and physiologists might collaborate with advantage.

A MEETING of the Society for Experimental Biology was held at Edinburgh University on July 17-19. A variety of papers was presented, including one on the growth of fish by Mr. J. Gray, the anterior pituitary and metamorphosis by Mr. E. A. Spaul, the fertilisation membrane of Echinus by Mr. A. D. Hobson, the kinetics of hæmolytic and bacteriolytic reactions by Dr. Ponder, and a demonstration of new methods for studying early stages of cell injury by Dr. Rettie. At a session held in the Botanical Gardens, Dr. K. Blackburn discussed the relation of plant chromosomes to sex, Dr. Philip Smith the effect of acidity on regeneration in Coleus, while Prof. Priestley considered the conceptions of stimulus-transmission and hormones in plants. One session was devoted to a visit to Dr. Crew's laboratory, where breeding experiments with many domestic animals were demonstrated and discussed This was followed by a dinner which was well attended. The next conference will be held in London in December

THE Report of the Director-General of Public Health, New South Wales, for the year 1924, recently received, contains details of the public health administration of the State and of investigations carried out for the Board of Health. In industrial hygiene an investigation has been made of the sandstone dust hazard among miners, quarrymen, and stonemasons It is recommended that a standard of not more than 200 dust particles per c c of air, as determined by the Owens' dust counter, should be adopted for the air of the workings, a figure which can easily be attained by proper methods and ventilation. No cases of plague occurred among human beings or rats. Of the latter, 16,351 were examined, and the species and number of fleas upon the rodents are recorded. Interesting details are given of cases of snake-bite and of paralysis following the bite of ticks.

A NUMBER of scientific expeditions to Arctic Russia and Siberia are announced in the *Weekly News Bulletin* of the U.S S R Society of Cultural Relations, No. 22, vol. 3. The Hydrographical Board has begun the exploration of Maligena Strait which separates Byeli Island from the north of the Yamal peninsula, on the northern sea route to Siberia. Another expedition has left Perm to study the flora and fauna of the Kara Sea, the Ob estuary and the Gulf of Taz. A third expedition, based on Muzhinskoe on the River Ob, is to study the northern Urals, particularly the valleys of the Sosva and Lyapin. Lastly, a geological examination of the coal and oil deposits of northern Sakhalien is promised.

THE Library of the Chemical Society will be closed for stocktaking from Monday, August 2, until Saturday, August 14, inclusive, and will close each evening at 5 o'clock from August 16 until September 11.

THE following have been elected officers of the Institution of Electrical Engineers for the year 1926–1927: *President*, Dr. W. H. Eccles; *Vice-President*, Colonel T. F. Purves; *Hon. Treasurer*, Lieut.-Col. F. A. Cortez Leigh.

APPLICATIONS are invited by the Dorset Field Club for the Cecil medal and prize of 10*l.* for the best essay on "The Wireless Transmission of Power, its Position and Prospects." The competition is open to persons between the ages of seventeen and thirty-five on May 31, 1927, and either born in Dorset or resident in the county not less than one year between May 1, 1925, and May 1, 1927. Particulars may be obtained from Mr F. H. Haines, Appleslade, Ringwood, Hants.

AT a meeting of the Council of the Royal Society of Arts held last week at Clarence House, H.R.H. the Duke of Connaught, President of the Society, presented the Society's Albert Medal for 1926 to Prof. Paul Sabatier, "in recognition of his distinguished work in science and of the eminent services to industry rendered by his renowned researches in physics and chemistry, which laid the foundation of important industrial processes"

NOTICES have been issued of a class in marine biology to be held at the Millport Marine Biological Station during the fortnight August 17-31. Facilities will be provided for collecting and the examination of living specimens, and those attending will be encouraged to investigate some particular problem. Lectures will be given by the Station staff and others on special subjects. Improved facilities for research workers are now available at Millport Laboratory, following the recent installation of electric plant.

THE following are among the recipients of Civil List pensions recently announced: Mrs Marian Dibdin (125*l*.), in recognition of the scientific work of her husband, the late Mr. W. J. Dibdin; Lady Dorothea Hosie (100*l*.), in recognition of the public, literary, and scientific services rendered by her husband, the late Sir Alexander Hosie; Mrs. Elizabeth Japp (100*l*.), in recognition of the services rendered by her husband, the late Prof. F. R. Japp, to the advancement of organic chemistry and chemical education.

IN our issue of July 24, p. 126, we referred to the retirement of Prof. J. A. Fleming from the chair of electrical engineering in the University of London (University College), which he has occupied with distinction since 1885. In recognition of his services to electrical science it has been decided, by a committee presided over by Mr. A. A. Campbell Swinton, to invite subscriptions for a portrait to be placed in University College, and a replica for Prof. Fleming himself, who wishes to offer it to the Institution of Electrical Engineers. Subscriptions should be sent to Prof. W. C. Clinton, University College, Gower Street, London, W.C.1.

WE have received a copy of Circular 279 of the U.S. Bureau of Standards on the relations between the temperatures, pressures, and densities of gases, prepared by S. F. Pickering of the Bureau. It is the purpose of the circular to explain simple methods of making calculations and solving problems involving the properties of gases. Detailed explanations of the gas laws and equations of state are presented together with a large number of charts, tables of data for various gases, and an extensive bibliography.

Natural History, the journal of the American Museum of Natural History, does much to popularise zoology and keep the public informed of discoveries in natural history as they are revealed by study and by exploration in various lands. Its issue for March-April 1926 (vol. 26, No. 2) is devoted to insects and contains a number of general articles admirably illustrated by coloured and half-tone figures. Among the contributors to this issue are Dr. L. O. Howard, who discusses the great economic waste occasioned by insects; Dr. J. Bequaert, who writes on insects and man in tropical America; and Dr. V. L. Kellogg, who describes the structure and functions of the wing-scales of butterflies.

THE British Museum (Natural History), South Kensington, London, S.W.7, has recently issued a fourth edition of the "Guide to the Exhibited Series of Insects" (price 1*s*.). It is a reprint of the previous edition except that a few slight alterations and corrections in the text have been made. Some idea of the magnitude of the main collection of insects that is contained in the Museum may be gathered from the fact that it is now estimated at 3,500,000 specimens comprised in about 250,000 named species. Only a very small representative series of these is exhibited in the public galleries, but the exhibit is sufficiently complete to give the public a general idea of the classification, forms, and habits of all the chief groups of these animals. The present guide serves as a useful brochure on the subject, and should be used by all who wish to make intelligent use of the specimens that are displayed for their benefit in the galleries. It is fully illustrated, and can be obtained either at the Museum or through booksellers.

THE latest catalogue (No. 484) of Mr. F. Edwards, 83A High Street, Marylebone, W.1, will be interesting to those on the look-out for books relating to the Far East, seeing that it gives particulars of many works on China, Formosa, the Indian Archipelago, Japan, Korea, and the Philippines.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A small live-stock instructress and an assistant for general agricultural instruction and dairying under the Surrey Agricultural Committee—C. R. Harding, County

Agricultural Officer and Secretary to the Agricultural Committee, County Hall Annexe, Kingston-on-Thames (August 4). Inspectors under the Ministry of Agriculture and Fisheries for the purposes of the Diseases of Animals Acts 1894–1925—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (August 9). A lecturer in agriculture at the Agricultural Institute, Plumpton—The Director of Agriculture, County Hall, Lewes (August 10). A lecturer in pathology at the Welsh National School of Medicine—The Secretary, University College, Cardiff (August 21). A senior metallurgist under the British Cast Iron Research Association—The Director, 75 New Street, Birmingham (August 27). A reader in physics at King's College, Strand—The Academic Registrar, University of London, South Kensington, S.W.7 (September 17). A male junior assistant under the directorate of explosives research of the Research Department, Woolwich—The Chief Superintendent, Research Department, Woolwich, S.E 18. A taxidermist for Public Museum -Prof. Carr, University College, Nottingham. A physics mistress at the Cowley Girls' School, St. Helens—The Secretary to the Governors, 17 Cotham Street, St. Helens.

Our Astronomical Column.

JULY METEORS.—Mr. W. F. Denning writes: "A few observations were made at Bristol between July 12 and 22, but meteors seemed somewhat scarce. The coming Perseid shower gave evidence of its presence on July 13 and 16, and several rather bright meteors were seen, presumably from radiants near α and ζ in Cygnus These are well-known showers at about $314° + 48°$ and $317° + 31°$ and appear to be pretty regular in their annual returns. On July 16 and 20, meteors were recorded from a shower directed from a point near α Capricorni ($304° - 12°$). A rather fine object, belonging probably to this stream, appeared on July 20, 2^h 25^m G.M.T., moving along a path of about 45° approximately between Jupiter and Mars and towards Mars. This meteor was seen by an assistant, who pointed out the position, but no other observations have as yet come to hand. This shower of Capricornids is one of considerable activity and seems possibly connected with comet 1881V. Its meteors were numerous in 1908 and 1916, but their chief abundance seems to occur a fortnight before the earth's nearest approach to the comet's orbit."

CHANGES IN THE EARTH'S RATE OF ROTATION.—Prof. Newcomb was the first to suggest that the unexplained oscillations in the moon's position might really be changes in the earth's rotation. Support was given to the suggestion by Glauert, Innes, and others, the test being that other rapidly moving bodies should show similar oscillations, agreeing in phase but differing in amplitude proportionally to their motion.

Prof. E W. Brown contributes a paper to the *Proc Nat Acad. of Sciences*, U.S A. (June 1926), on the subject. He strongly supports the hypothesis, finding, *inter alia*, confirmation from the observations of the sun: there has been a marked deviation from the tables since 1900, which now amounts to 1″ He considers that an oscillation in the earth's radius appears to be the only way of producing such changes in the rotation. Such oscillations were already postulated by Joly ("The Surface of the Earth"), but these are of much longer period than those required for the present research. The chief unexplained lunar term has a period of some 2½ centuries, found by Prof. Turner to be about the same as a period indicated by Chinese earthquakes. The amount of oscillation in the radius required by Brown lies between 5 inches and 12 feet according to the depth of the source, which he estimates to be at least 80 kilometres.

MUTUAL ECLIPSES OF JUPITER'S SATELLITES.—Once in six years the orbit planes of Jupiter's satellites are turned edgewise to the sun, and mutual eclipses of one satellite by another occur. These phenomena have very seldom been observed, for they last so short a time that, unless notice is given beforehand, they are likely to escape detection. The Computing Section of the British Astronomical Association has now undertaken the computation of these phenomena, and gives lists of them for June, July, and August in the March and April issues of its journal. Unfortunately, after July 6, none is visible in England until Aug. 4, when III. is eclipsed by II. at 21^h 28^m. Mr. B. M. Peek described at the June meeting of the Association his observations of three of these phenomena. On June 17, I. was partially eclipsed by II.; at mid eclipse their magnitude was equal, I having been ½ mag. brighter before eclipse. On June 23, III. was eclipsed by II., the loss of light being very appreciable, so that III. became equal to II. On June 28 there was an annular eclipse of II. by I., of very brief duration, since the motion of the satellites was in opposite directions. Fading began at 23^h 46^m 15^s, centrality occurred 23^h 46^m 45^s, and II. suddenly brightened at 23^h 47^m 10^s.

THE REFLECTION EFFECT IN ECLIPSING VARIABLES.—In some cases of eclipsing binaries the light is not constant during the period between two eclipses, owing to reflection of the brighter star's light by the secondary. The hemispheres of the fainter stars facing and remote from the primary are of unequal luminosity and produce a well-recognised effect on the light curve of the system. The theory of this reflection effect is discussed by Eddington in the *Monthly Notices, Roy. Ast. Soc.*, vol. 86, p. 320 (March 1926). He considers primarily the case of the reflection of heat energy, which is greatly simplified by the fact that the 'heat albedo' 1 (*i.e.* a star re-emits completely the radiation falling on it). The phenomenon considered in the theoretical case is not strictly one of reflection, but of absorption and re-emission of radiation, and the conclusions obtained are translated into terms of light reflection by means of simple assumptions. It is shown that the 'reflection' coefficient for heat will not be greater than that for light, and calculated theoretical values are compared with observed values of the reflection effect, in the case of systems of known orbits. Good agreement is shown between the calculated heat reflection and the observed light reflection in seven systems out of twelve, and (contrary to expectation) in only one case is the light reflection the greater of the two. The assumption that the incident radiation is re-emitted in amalgamation with the natural radiation of the fainter star as black body radiation would imply a large increase of the luminous efficiency of this star. The absence of this effect in observed systems suggests that the incident light retains its original quality after 'reflection.'

Research Items.

SANATORIUM TREATMENT OF PULMONARY TUBERCULOSIS.—"Although it was at one time believed that sanatoria were effective in curing phthisis, and at the present time it is tacitly assumed that they are at least effective in favourably influencing the progress of the disease, it has never been satisfactorily proved that such is really the case." With the assistance of M. Noel Karn, Dr. Percy Stocks has made an elaborate study of the first 2794 consecutive cases of undoubted pulmonary tuberculosis brought under the survey of the Belfast Tuberculosis Dispensaries from 1914 onwards. His results, published in *Annals of Eugenics*, vol. 1, parts 3 and 4, show that the average ultimate progress, as estimated over a period of six years unless the patient had been previously lost to view, was undoubtedly worse in the case of the sanatorium-treated than in the case of patients otherwise treated, for cases first seen in the incipient stage, but was not significantly different for patients first seen in advanced stages. Judged by the proportion in whom the disease became arrested or apparently cured, sanatorium treatment showed a temporary superiority during the first two or three years which was lost in subsequent years. While length of stay at a sanatorium was not found to be correlated with ultimate progress, there was an appreciable relation between regularity of dispensary treatment and progress. No consistent evidence was found that bad housing conditions, as judged by rent, class of house, state or cleanliness of rooms, or overcrowding, had any influence on ultimate progress or rate of recovery. The authors suggest that sanatorium treatment should be reserved for patients diagnosed *very early*, those so ill as to require hospital treatment, or those whose circumstances demand their removal from home.

LOUISIANA MOUND BUILDERS.—Dr. J Walter Fewkes, Bureau of American Ethnology, has been engaged during last winter in excavating on the Red River mounds near Marchville, Louisiana, which are, it would appear, of an origin entirely obscure. Breastworks two-thirds of a mile long and 20 mounds, of which the largest, flat on top, is 12 feet high and covers 3 acres of ground, suggest a population of some considerable size. Yet the archæological evidence which has been obtained by excavation suggests a culture of low standard precariously existing in an unfavourable environment. The structure of the mounds varies considerably from that of the Mississippi tribes, Natchez, Choctaw, and others east of the river, or of the Caddo, to the west The mounds appear to be older than those of the Mississippi Valley, and contain no evidence of contact with the white man. They are very poor in artefacts, and it is clear that the living afforded by the area was precarious and meagre. The larger of the mounds contains remains of many skeletons. There are 8 lodge-sights, circular excavations supported by a low embankment. When settlers first visited the country the site of the mounds was occupied by a small tribe of Avoyelle Indians

LUMINESCENCE IN EARTHWORMS.—G. E. Gates (*Records Indian Mus.*, vol. 27, part 6) has observed that four species of earthworms which occur in Rangoon eject from the dorsal pores, after mechanical or chemical stimulation (*e.g.* weak ammonia solution), a mucoid substance which is luminous in various degrees according to the species of worm from which it has issued. The light is not immediately forthcoming on the discharge of the mucus, but appears after a short interval and gradually increases to a maximum. The earthworms are respectively three species of Eutyphœus and one species of Megascolex; no species of either genus has hitherto been reported as luminous.

THE PREVENTION OF DAMAGE BY TERMITES.—Termites or 'white ants' are among the most destructive pests in tropical and subtropical countries. They are well known in these lands to cause serious injuries to woodwork and foundations of buildings, and to furniture and other manufactured articles, as well as injuring trees, crops, and other vegetation. At one time it was believed that the life of a termite colony was dependent upon the presence of the greatly enlarged queen individual, and if she were destroyed, the community would be quickly exterminated. We now know that in the event of her destruction, the life and reproduction of the colony is maintained by other types of queens which, although showing little increase in size, make up in fecundity by their numbers. In *Farmers' Bulletin*, No. 1472 of the U.S. Department of Agriculture, Dr. T. E. Snyder has provided a useful brochure dealing with combating these insects. He recommends that the foundation of buildings should be made of stone, brick, or concrete, including stone or metal columns in the basement to support the floor above. Walls and flooring in basements or cellars should be of concrete, and in no case should untreated timbers be sunk into the ground Where timber is the only practicable material, it should be first impregnated with coal-tar creosote. Complete dryness of foundations of basement flooring is an important means for rendering buildings safe from attack. Many details referring to termite attacks under various conditions will be found in this bulletin, together with recommendations concerning their elimination from cultivated lands

GENETICS OF THE SWEET PEA.—The sweet pea, *Lathyrus odoratus*, was one of the earliest objects of genetical study in the beginning of the neo-Mendelian period. The first case of what is now known as linkage and crossing-over was described in this material As the genetical work with this plant proceeds, the number of linkage groups of characters is still, in the work of Punnett, fluctuating about the haploid number (7) of chromosomes. Partial studies of the pollen development have been made, but the first thorough cytological investigation has recently been published by Miss J. Latter (*Annals of Botany*, April 1926). Several discoveries of much interest are recorded; no more critical paper has appeared in cytology for several years. During the thread stages of meiosis in the pollen mother cell, a definite dark-staining body is discovered in the nucleolus, and it is shown to be invariably connected with a loop of the spireme It grows in size and apparently serves to pass elaborated material from the nucleolus on to the thread There is some evidence that it is derived from a crystalline body which is constantly present in the nucleolus at an earlier stage. The spireme thread shows a telosynaptic history, which is traced with great accuracy. Finally, seven loops are formed radiating from the centre of the nucleus. This is the stage which Gates has called brochonema. During this stage the two arms of each loop, representing a pair of chromosomes, are frequently twisted about each other, thus providing a possible basis for

Fuels," Dr. Ormandy and Mr. D. Ross dealt with the use of alcohol as a motor fuel when mixed with petrol or benzol. Alcohol has the great advantage that it allows the use of a much higher compression ratio in the engine than petrol or any constituent of petrol, thereby obviating premature detonation ('pinking'). Commercial (95 per cent. vol.) alcohol does not mix well with petrol, but now that alcohol can be easily and economically dehydrated by distilling azeotropic mixtures, this difficulty has disappeared. Road tests carried out by the London General Omnibus Co. using petrol with a small proportion of 99 per cent. alcohol, and a mixture of 65 per cent. denatured alcohol, 30 per cent. benzol, and 5 per cent. ether gave quite satisfactory results and showed that, owing to its anti-detonating action, alcohol can advantageously be added to low-grade petrols to improve their value.

The great importance of the size of particles of pigment and compounding powders used in the paint and rubber industries, was discussed at a conference presided over by Sir William Bragg. After Dr. D. F. Twiss and Mr. C. A. Klein had outlined the main problems, specialised papers were read by Dr. S. S Pickles, Dr. P. Schidrowitz, Mr. T. R. Dawson, Mr. Nöel Heaton, Mr. E. A. Murphy, Mr. H. Green (U.S.A.), and by Messrs. G. Gallie and B. D. Porritt. At the concluding sessions Mr. L. J. Simon and Prof. J. W. Hinchley contributed a paper on fat-extraction by solvents, in which they described a new large-scale process for extracting fat from seeds which involves a very short period of extraction, economy in the consumption of solvent, and low capital cost; and Dr. E. W. Smith presented a very useful summary of recent discussions concerning solid smokeless fuel Low-temperature processes, said the author, are at present both technically and economically unproven and the immediate problem consists in improving high-temperature coke for industrial and domestic uses. Such coke must be dry, and contain as low an ash-content as is compatible with economic production. It must be suitably graded, and the grades standardised.

The attendance at all the conferences was very good, and the papers were of a high standard, although there were so many of them that little time was left for discussion Considered as a whole, the meeting was remarkable not only for its magnitude, but also for the diversity and interest of the subjects discussed.

The Commercial Production of Hormones.

AT a joint meeting of the Biochemical Society and the London Section of the Society of Chemical Industry on July 20, a series of papers on "The Scientific and Industrial Problems presented by the Hormones—the Natural Drugs of the Body," was read. The chair was taken by Sir Alfred Mond, who, in the course of his introductory remarks, referred to the work done by the British school on this subject and to the success which has followed the co-operation of the biochemist, the manufacturer and the physiologist, especially in the commercial production of insulin. The financier, though doubtless an essential member of the team, should occupy a subsidiary position to the research worker. Dr. H. H. Dale followed with a paper on the experimental study and use of hormones; Dr. H. W. Dudley described the chemistry of the pituitary gland and of insulin, and Mr. F. H. Carr the commercial production of hormones; Dr H. A. D. Jowett gave an account of the history of adrenaline, and Prof G. Barger discussed the recent progress in the chemistry of thyroxine. Dr. J. W. Trevan's paper on the biological assay of hormones was not read, but in the following account of the main parts brought out by the various speakers, use has been made of an abstract with which we have been furnished.

Only one of the hormones has, so far, been synthesised in the laboratory. Although the presence of a pressor principle in the suprarenal gland was first shown by Oliver and Schafer in 1894, it was not until 1901 that it was obtained in the crystalline state by Takamine, who, with greater courage than was shown by previous investigators, added strong ammonia in excess to the purified aqueous extract of the gland and so precipitated the base. In the same year Aldrich assigned it the formula $C_9H_{13}O_3N$, and this was afterwards confirmed: its structure was definitely proved by Jowett in 1904, who, by exhaustive methylation and subsequent oxidation, obtained veratric acid and trimethylamine, and about the same time the compound was also synthesised by Stolz. The synthetic product was of course the racemic form: in 1908 Flacher separated the dextro- from the lævo- variety, by treating the bitartrate with methyl alcohol, which dissolves the former and leaves the latter behind. The pressor effect of the lævo- naturally occurring form is fifteen times greater than that of its isomer

Although the chemist may have finished with adrenaline, to the biochemist and physiologist it is still the central figure in many unsolved problems. How does the body make it? What is its function under ordinary conditions of life? To the first question there is as yet no answer: to the second a tentative reply may be given, but it is a curious fact that, although adrenaline has so simple a chemical constitution, and such a powerful physiological action when injected, yet its presence in the body under ordinary conditions, except in the suprarenal glands themselves, has been extremely difficult to demonstrate satisfactorily; in fact it has even been denied that it has any function in ordinary circumstances. It is probable, however, that it plays a part in the maintenance of the tone of the small blood-vessels, and also is secreted into the blood stream in larger quantities under conditions of emotional and physical stress.

It is interesting to contrast with the history of adrenaline that of thyroxine. The administration of thyroid gland in myxœdema was the first example of a successful substitution therapy: it is still the main example of this type of treatment, and, excepting possibly the oxytocic principle of the pituitary gland, the only example of a successful result being obtained by administration by the mouth. It is stated to have been used in China for this purpose more than a thousand years ago. But the active principle was not isolated until a few years since, when Kendall was successful in preparing it. Within the last year Harington has been able to synthesise desiodo-thyroxine, the compound formed when the iodine is removed from the molecule of thyroxine. An account of Harington's work has been recently given in these columns (July 10, p. 65), so that it will not be further discussed here: it may be assumed that the final synthesis is now only a matter of time.

The commercial production of other hormones, of which the chemical constitution is unknown, requires the supervision of skilled chemists in the process of manufacture, and the co-operation of the research biochemist in the improvement of existing processes

or the discovery of new ones; the physiologist is also required, since the detection of the presence of the hormone and its quantitative estimation require the use of animal tests in the absence of satisfactory chemical reactions. The usefulness of this co-operation has never been more successfully shown than in the commercial production of insulin. At the present time firms in Great Britain satisfy all home requirements, and have a large balance available for export, whilst the price is low enough to bring the remedy within the means of the poorest diabetic. Of the hormones of, at present, unknown chemical constitution, insulin and those of the posterior lobe of the pituitary gland are the best known. Secretin, the hormone which arouses the secretion of pancreatic juice at the inflow of the partially digested food from the stomach into the duodenum, from the mucous membrane of which it is absorbed into the blood stream, has been recently obtained in a very pure form by J. Mellanby. The active principle of the parathyroid glands and the œstrus-producing hormone of the ovary have been extracted and partially purified, and methods of biological assay, which are probably roughly quantitative, worked out. Of the active principles of the testes, the cortex of the suprarenal glands and the anterior lobe of the pituitary, almost nothing is known; but our ignorance is not due to their non-essentiality, since both the suprarenal cortex and the anterior pituitary are essential to life, whilst an inkling of their functions has been obtained from human and experimental pathology.

An insight into the manufacturing problems is given by a knowledge of the properties of these hormones; insulin and the pituitary hormones may serve as a basis for the following short description. It is probable that the active principles exist in the glands in a combined form, from which they are set free by appropriate treatment; this is certainly the case with thyroxine and probably also with adrenaline. Under certain conditions the hormones will even stand boiling, but, apart from this, their main characteristic is their exceeding sensitiveness to even quite mild reagents. They are rapidly destroyed by autolysis after the death of the animal, being attacked by proteolytic enzymes, though to varying degrees.

This is also probably the reason why the majority are inactive when taken by the mouth, except in relatively enormous doses. They are extremely sensitive to alkalies, but are stable in the presence of weak acids. They appear to be either themselves simple proteins such as an albumose or polypeptide or are closely associated with them. They adhere tenaciously to precipitates formed in their aqueous solutions. Thus Dudley obtained a crystalline picrate from a concentrated aqueous solution of the pituitary hormones, which retained in full its physiological activity when re-crystallised from water; but on re-crystallisation from dilute alcohol, the activity remained behind in the mother liquor, whilst the crystals were identified as potassium creatinine picrate. Abel has recently announced the isolation of a crystalline insulin, the activity of which is two to four times greater than that of ordinary commercial insulin; the crystals bear a remarkable resemblance to cystine. Now it is known that if edestin is allowed to crystallise in a solution of insulin a great part of the activity adheres to the crystals, so that, until further evidence is forthcoming, caution should be exercised in accepting Abel's conclusion.

The principles to be followed in the production of hormones on the large scale must therefore be the inhibition of enzyme action, and the avoidance of the use of destructive reagents or the production of precipitates which remove the activity, except where the latter can be used as a method of purification with recovery of the active principles from the precipitate. The prevention of autolytic changes is best ensured by the freezing of the glands immediately after removal from the animal. The material can then be worked up at leisure and in convenient quantities, though slow changes occur in time in the frozen state, leading to lowered yields. In working up the glands, every means should be taken to prevent enzyme action: thus in the case of the pancreas, the frozen glands are minced, the acid and alcohol incorporated at a temperature of 0° C., and the whole thoroughly ground; filtration and clarification follow to remove, so far as possible, traces of adhering enzymes, and the subsequent concentration is carried out at a low pressure and temperature. In the case of the pituitary gland, dehydration with acetone at a low temperature destroys the autolytic enzymes, leaving a stable powder from which the activity can be extracted by water or dilute acid. The acidity of the solution is of great importance in the case of both insulin and the pituitary hormones. Moreover, use is made of the fact that insulin is insoluble at *p*H of about 5·0 in the later stages of the purification, so that it is essential that those working on the insulin plant should be able to determine the hydrogen ion concentration of the solutions with which they are dealing: a colorimetric method is easy to learn and gives sufficiently accurate information. In the final stages of the preparation of insulin, use is made of Dudley's method, precipitation with picric acid followed by addition of alcoholic hydrochloric acid, by which treatment the insulin hydrochloride is formed and can be precipitated with acetone as a uniform white powder.

In conclusion, reference may be made to one further point in which the co-operation of the manufacturer, the biochemist, and the physiologist may lead to important results. To obtain further insight into the chemical nature of these unknown active principles requires the provision of a moderately large quantity of relatively pure material as the starting point for further analysis. The posterior lobe of the pituitary gland of the ox weighs about 0·5 gm., of which 0·1 gm. is solid matter. Probably less than 0·1 per cent. of this represents the active principles: in other words, to obtain 100 gm. of 'pure' hormone would require the working up of glands from 1,000,000 oxen, with the probability that this material would still be a mixture of active principles and contaminating substances. Large scale working, over a course of years probably, seems the only way to accumulate sufficient material on which the biochemist can commence his research, and until the principles have been isolated in a pure condition, identified and synthesised.

The co-operation of the physiologist will be essential in tracing the course of the hormone through the necessary chemical manipulations. Moreover, until our chemical knowledge of these hormones is complete, quantitative estimation of them can only be carried out by the aid of animal tests. By the use of suitable preparations or a sufficiently large number of animals, the errors in this method of assay can be reduced within reasonable limits: thus for pituitary standardisation (on the virgin guinea-pig's uterus), the error of a single test is ± 20 per cent., and for insulin assay ± 5-10 per cent. Such differences as these would scarcely be detected in clinical medicine, so that the method of biological assay sufficiently safeguards both the physician and the patient.

University and Educational Intelligence.

CAMBRIDGE.—Mr. T. C. Hodson has been appointed reader in ethnology in succession to Dr. A. C. Haddon.

EDINBURGH.—At the graduation ceremonial on July 20, the following, among others, were presented for the honorary degree of Doctor of Laws: The Earl of Crawford and Balcarres, Chancellor of the University of Manchester, a trustee of the British Museum, and president in 1916 of the Board of Agriculture and Fisheries; emeritus Prof. J. S. Nicholson, formerly professor of political economy in the University of Edinburgh; Lord Salvesen, formerly president of the Zoological Society of Scotland and of the Royal Scottish Geographical Society.

The degree of Doctor of Science was conferred on Dr. D. A. W. Fairweather for a thesis on "Electrosynthesis"; Dr. S. R. Khastgir for a thesis on "Studies in the J-transformation of Scattered X-radiation"; Dr. J. Muir for a thesis on "The Flora of Riversdale, South Africa"; Mr. J. D. M'B. Ross for a thesis on "A Relationship between the Associating Power of Optical Isomers, and the Formation of Racemic Compounds"; Dr. G. Shearer for a thesis on "The Application of the Method of X-ray Analysis to the Study of the Organic Aliphatic Series."

At the medical graduation ceremonial on July 23, intimation was made of the award of the Cameron Prize in practical therapeutics to Dr. H. H. Dale, head of the Department of Biochemistry and Pharmacology under the Medical Research Council, for important investigations on the pharmacological and therapeutic action of a series of substances which have effects on the functional activity of nerve, muscle, ductless glands, and other tissues.

LEEDS.—Mr. A. E. Ingham, Fellow of Trinity College, Cambridge, has been appointed reader in mathematical analysis in succession to Dr. W. E. H. Berwick. Mr. Leonard R. Johnson has been appointed assistant lecturer in agricultural zoology.

LONDON.—Mr. E. B. Verney has been appointed as from August 1 to the University chair of pharmacology tenable at University College. Mr. Verney was educated at Tonbridge School, and at Downing College, Cambridge. He was assistant in the Department of Physiology at University College from 1921 until 1924, and since 1924 has been assistant in the Medical Unit at University College Hospital. In July 1922 he was awarded a Beit Memorial Fellowship and was re-elected for a 4th year in 1925.

Mr. S. J. Davies has been appointed as from August 1 to the University readership in mechanical engineering tenable at King's College. He was educated at H.M. Dockyard School and the Technical College, Portsmouth. Since 1920, Mr. Davies has been senior lecturer in engineering at Armstrong College, Newcastle-upon-Tyne; he has also lectured at the Technische Hochschule in Charlottenburg and in Düsseldorf and Essen.

The title of emeritus professor of electrical engineering in the University has been conferred on Prof. J. A. Fleming, on his retirement from the University chair of electrical engineering at University College.

THE honorary degree of D.Sc. of the University of Wales has been conferred on Sir T. W. Edgworth David, professor of geology in the University of Sydney, for distinction as a geologist and his eminent position in the university life of Australia; and on Dr. A. H. Church, University lecturer in botany, Oxford, for his distinguished contributions to botanical science.

NOTICE is given by the Huddersfield Technical College of the forthcoming award of the two following research scholarships, each of which is of the yearly value of 100*l.*, with remission of fees: The Joseph Blamires' (for research in colour chemistry), and the Drapers' Company's (tenable in the dyeing department). Particulars of the scholarships are obtainable from the principal of the college.

THE College Research Committee of Armstrong College, Newcastle-upon-Tyne, has recently initiated a new scheme under the title of Senior Research Fellowship. A member of the staff elected to a fellowship is released from teaching duties for one year, the Research Committee providing the salary of a temporary lecturer from the funds at its disposal. A first appointment has been made of Dr. G. R. Goldsbrough, lecturer in applied mathematics.

THE Trustees of the Beit Fellowships for Scientific Research at their annual meeting extended the fellowship awarded a year ago to Mr. Rudolf Kingslake for mathematical and experimental researches on the properties of optical instruments. Three new fellows were elected: Mr. J. Topping for research on the calculation of the equilibrium configuration and energy of crystals from the mutual electrostatic and repulsive forces, in particular Al_2O_3 and Fe_2O_3; further extension of the research upon which he is at present engaged and the calculation of the repulsive forces for the nitrate crystals and further comparisons of calcite and aragonite; Mr. J. W. Maccoll for research in aerodynamics; and Mr. G. H. Mitchell for research on the Borrowdale volcanic rocks of the eastern part of the Lake District, more especially in the Kentmere and Troutbeck areas, in continuance of research now being pursued. For the first time in the history of the Trust, the appointments are for the definite period of two years instead of for one year as hitherto.

THE Education Committee of the London County Council, on the advice of its Consultative Committee on Engineering, has awarded Robert Blair Fellowships to Mr. Malcolm D. Bone and Mr. Eric W. Fell. These fellowships, which are of the value of 450*l.*, are awarded to young engineers of high promise to enable them to undertake research overseas. Mr. Malcolm Bone, who is a student-assistant with the Consett Iron Co., is the son of Prof. W. A. Bone, of the Imperial College of Science and Technology, South Kensington. He was educated at St. Albans Grammar School, Mill Hill School, the Friends' School, Sidcot, and the Imperial College. He will now study iron and steel manufacture in continental works, mainly in Germany. Mr. Eric Fell is a research student in the University of Birmingham who was previously educated at St. Aubyns School and Haileybury. Like Mr. Bone, he also proposes to study in Germany and to undertake research in the metallurgy of steel at the Technische Hochschule, Aachen. Four Robert Blair Fellowships have already been awarded for research in the United States, Canada, and in Germany. The first research report written as the result of these awards has recently been received from Mr. George Bird, who gained a fellowship two years ago. This report has been forwarded to the Institution of Mechanical Engineers, with the result that Mr. Bird has now been invited to write a paper, dealing with some particular phase of his investigations, for publication in the proceedings of the Institution.

Contemporary Birthdays.

July 28, 1864. Prof. Charles Herbert Lees, F.R.S.
July 30, 1856. Viscount Haldane, K.T., O.M., F.R.S.
Aug. 2, 1876. Prof. James Wesley Jobling.
Aug. 5, 1878. Prof. Louis C. Karpinski.
Aug. 7, 1864. Mr. Oswald H. Latter
Aug. 8, 1845. Mr. William Barlow, F.R.S.
Aug. 8, 1859. Sir Alfred G. Bourne, K.C.I.E., F.R.S.
Aug. 8, 1857. Prof. Henry Fairfield Osborn, For Mem. R.S (see page 163).
Aug. 8, 1858. Sir Francis G. Ogilvie.

Prof. LEES, who occupies the chair of physics in the University of London (East London College), was born at Glodwick, Oldham. He was educated privately, then at Owens College, Manchester, and at the University of Strasbourg. Before engaging in professional work in London he was lecturer in physics in the University of Manchester.

Lord HALDANE, Chancellor of the University of Bristol since 1909, was educated at Edinburgh Academy, the University of Edinburgh (of which he was rector, 1905-8), and at Göttingen. He is Hon. D.C.L. (Oxon). Among many critical expositions, he is the author of "The Philosophy of Humanism" (1922). Lord Haldane is president of the British Institute of Adult Education.

Prof. J. WESLEY JOBLING was born in Ohio. Originally on the teaching staff of Columbia University, he was professor of pathology from 1914 until 1918 in the medical department of Vanderbilt University, Nashville (Tennessee), returning then to Columbia to occupy the chair of pathology there

Prof. LOUIS C KARPINSKI, mathematician, was born at Rochester, N Y. He was educated at the State Normal and Training School, Oswego, N.Y., and the University of Strasbourg Since 1910 he has been professor of mathematics in the University of Michigan He is joint author with H Y. Benedict and J. W. Calhoun of "Unified Mathematics" (1918).

Mr OSWALD LATTER, who has been for many years science master at Charterhouse School, was born at Fulham. From Charterhouse he went to Keble College, Oxford Sometime Berkeley fellow of Owens College, Manchester, he was also a tutor of Keble before returning to his old school to take up science teaching

Mr. WILLIAM BARLOW is a Londoner. He is specially identified with researches on crystal structure and related problems. Mr. Barlow is a past president of the Mineralogical Society.

Sir ALFRED BOURNE, a native of Lowestoft, was educated at University College School, London. His services to the Indian Empire have been varied and distinctive. Successively he has been registrar of the University of Madras, botanist to the Madras Government, and professor of biology in the Presidency College, Madras.

Sir FRANCIS OGILVIE, an Aberdonian, graduated at the University of Aberdeen, and, early in his career, was on its teaching staff. In Edinburgh he had, later, various important interests. He was principal of the Heriot-Watt College there from 1886 until 1900, thereafter, for three years, director of the Edinburgh Museum of Science and Art. Transferred to London, he was Secretary of the Board of Education for the Science Museum and Geological Survey from 1910 until 1920, holding also the directorship of the Science Museum. Sir Francis was principal assistant-secretary, Department of Scientific and Industrial Research, 1920-22. He is Hon. LL.D., Edinburgh.

Societies and Academies.

DUBLIN

Royal Irish Academy, June 28.—**H. Ryan, J Keane**, and **B. O'Donoghue**: Some derivatives of γ-piperonylidene-methylethylketone. The present communication describes the results of experiments carried out with this substance and some aromatic aldehydes. The starting substance, $CH_3 . CO . C(CH_3) = CH . C_6H_3 . O_2CH_2$, was prepared by the condensation of piperonal and methylethylketone in the presence of hydrochloric acid. By the action of piperonal on γ-piperonylidene-methylethylketone in the presence of alkali, a compound having the formula $C_{20}H_{16}O_5$ was obtained. This dicondensation derivative did not react with a further quantity of piperonal in the presence of alkali, and it was regarded as being 1-methyl-4·5-dipiperonyl-cyclopenten (3)-one (2). On treating this compound with alcoholic hydrochloric acid, it was converted into the isomeric 1-methyl-4·5-dipiperonyl-cyclopenten (4)-one (2). This substance reacted with piperonal in the presence of alkali to form a tricondensation compound $C_{28}H_{20}O_7$. By the action of piperonal on γ-piperonylidene-methylethylketone or on the $C_{20}H_{16}O_5$ body in the presence of hydrochloric acid, the same tricondensation compound $C_{28}H_{20}O_7$ was obtained. This derivative is regarded as being 3-piperonylidene 1-methyl-4·5-dipiperonyl-cyclopenten (4)-one (2). The results obtained in this research are similar to those found by Ryan and Lennon in their investigation on the condensations of aldehydes with methylethylketone.—**H. Ryan, J. Keane**, and **B O'Donoghue**: Some derivatives of α-piperonylidene-methylethylketone. The results of the interaction of α-piperonylidene-methylethylketone and some aromatic aldehydes are described. By the action of piperonal on the starting substance, a compound having the formula $C_{20}H_{16}O_5$ was obtained. This dicondensation derivative of methylethylketone and piperonal was not identical with either of compounds having the same molecular formula obtained by the action of piperonal on γ-piperonylidene-methylethylketone. The last-mentioned derivatives are regarded as isomeric cyclopentenones. The $C_{20}H_{16}O_5$ body prepared by the action of piperonal on α-piperonylidene-methylethylketone formed a tetrabromide and did not react with a further quantity of piperonal. It is regarded as α-γ-dipiperonylidene-methylethylketone. By the action of piperonal on α-piperonylidene-methylethylketone in the presence of hydrochloric acid, a tricondensation compound $C_{28}H_{20}O_7$ was obtained. This body was also prepared by the action of piperonal on γ-piperonylidene-methylethylketone and was proved to be 3-piperonylidene-1-methyl 4·5-dipiperonyl-cyclopenten (4)-one (2).—**R K. Boylan**: Atmospheric dust and condensation nuclei. As a result of observations made in Dublin between October 1925 and June 1926, using Owens' jet dust counter and Aitken's apparatus, the following average values were obtained: dust particles per c.c. 1580, nuclei per c.c. 23,800. The correlation coefficient between the concentrations of the two bodies was 0·73 · 0·056. It was found, in confirmation of the results of Wigand, that dust particles would not act as centres for cloudy condensation even in the absence of the ordinary nuclei.

EDINBURGH.

Royal Society, July 5.—**J. Tait**: Experiments and observations on Crustacea (Pt vii.). Some structural and physiological features of the valviferous isopod Chiridotea. This isopod is found along the eastern shores of America. It is peculiar among its kind in that it combines the activity of swimming, walking,

and tunnelling in sand, and the position and arrangement of its limbs may be interpreted in relation to each of these purposes as well as in relation to its habits of feeding.—Norman **Maclaren**: Development of Cavia Implantation. The theory put forward by Graf von Spee, that in the guinea-pig the ovum is implanted in the uterine mucosa after the manner of a parasite in virtue of the destructive action of its surface cells, has been generally accepted. An alternative theory for the primary phases of implantation here discussed brings the process in Cavia more into line with what is known to occur in other mammals. Instead of eating its own way through the epithelium, the egg becomes lodged in one of the crypts which normally occur at the antemesometral end of the uterine lumen. This crypt becomes closed by the overgrowth of its lips, while the epithelium which originally formed its floor disappears. With the disappearance of the epithelium, destructive changes supervene in which the whole antemesometral part of the lumen is involved. The primary implantation cavity is thus a part of the uterine lumen, and the process does not, in principle, differ from that which occurs in certain other rodents such as the mouse and rat.—W. L. **Ferrar**: On the cardinal function of interpolation theory. Interpolation over a set of equi-distant points by cardinal function formula is 'consistent,' *i.e.* a function which is given accurately by the interpolation formula applied to the values of the function at points 0, $\pm nw$ is also given accurately if w be replaced by any smaller w'. The formula consists of an infinite series; its relation with a corresponding infinite integral is considered.—E. L. **Ince**: Researches into the characteristic numbers of the Mathieu equation. (Second paper.)

SHEFFIELD

Society of Glass Technology, June 1 and 2.—Sir W. Flinders **Petrie**: Glass in early ages. No glass was made in Egypt prior to about 1500 B.C., all earlier specimens being imported, probably from the Syrians. Examples of glass had been found in Syria, in the Euphrates region, which can definitely be dated back to 2500 B.C. Only fifty years or so elapsed between a time when glass was a comparatively rare commodity in Egypt and a time when it was possibly the commonest commodity of all. Glass vases and glass beads rapidly came into everyday use. At first it was not a liquid glass which was produced, but a glass paste which could be moulded in the plastic state. No blown glass was found in Egypt until one came to an examination of the products of the Christian period. The whole of the earliest glasswares discovered in Egypt were coloured. It was not until about 1200 B.C. that the Egyptians began to make glass by pressing it into moulds, and from thence onwards, until the seventh century B.C., the colour of their glasswares got worse and worse, although the patterns became more and more composite. From the year 350 A.D. the Egyptian glass-makers resorted to the moulding of glass in the production of standard weights for gold coins, a practice which was later copied by the Arabs. The glazing of stones began in Egypt about the twelfth century B.C. Some of the tiles covering the walls of early Egyptian chambers are magnificent examples of colouring; not only single colours were achieved, but also polychromes.—J. W. **Ryde**: Opal glass. A number of commercial and experimental glasses have been examined by the X-ray method in order to determine the nature of the opacifying material which separated out. Sodium fluoride and calcium fluoride had separated out from the glasses examined. The rates of cooling were controlled, and varied so that the effect of the rate of cooling on the depth of opal produced could be investigated. With slow cooling the size of particles which separated out increased until a certain limiting size was reached. In bulbs made of opals in which the opacifying particles are relatively large, very little light is scattered back to traverse the bulb again.—F. F. S. **Bryson**: The electrical conductivity of glasses at high temperatures. The electrical conductivity of several series of glasses was determined at temperatures between the softening point and 1150° C. The glass was heated in a small cylindrical crucible in a platinum wound electric furnace. The temperature-resistance curves for several glasses bear a close relationship to the temperature-viscosity curves for similar glasses, and suggest the possibility of using conductivity measurements as a method of determining changes in the viscosity of a glass immediately before being worked.—Edith M. **Firth**, F. W. **Hodkin**, M. **Parkin** and W. E. S. **Turner**: The influence of moisture on the rate of melting and on the properties of soda-lime glasses. Moisture was present in amounts ranging from 0·25 to 15 per cent. in different batches. In general, when present to the extent of not more than 1-2 per cent. in soda ash batches and not more than 3-4 per cent. in batches containing both soda ash and saltcake, moisture has a beneficial effect on the rate of melting. The glasses which were made from batches containing saltcake, were refined more easily, and were freer from waviness than those prepared from batches containing soda ash only. Glasses prepared from batches containing more than 5-6 per cent. of moisture were more viscous and had a shorter working range than those prepared from ordinary dry batches.

PARIS.

Academy of Sciences, June 21.—A. **Lacroix**: Preliminary note on an aerolith discovered in the Department of the Côte-d'Or and remarks on the classification and nomenclature of the chondrites.—Charles **Richet** and P. **Lassablière**: The protective effects of preliminary saline injections on chloroform anæsthesia. Experiments on dogs have proved that the injection of a solution of common salt into the veins before administering chloroform increases the resisting power of the heart. The amount of chloroform can be increased to six times the normal without collapse.—Gabriel **Bertrand** and M. **Mâchebœuf**: The influence of nickel and cobalt on the action produced by insulin in the rabbit. It has been shown previously that the pancreas is one of the organs containing the largest proportions of nickel and cobalt, and preparations of insulin are even richer in these two metals. This suggested the study of the effect of adding nickel or cobalt or both to preparations of insulin and examining the physiological effect. The effects, which are marked, are shown in a series of graphs.—E. **Bataillon**: The membranogen process and the regular development provoked in virgin eggs of Echinus by hypertonic treatment alone.—Pierre **Weiss** was elected a non-resident member in succession to the late G. Gouy.—A. **Buhl**: The integration of Maurer's equations by series of homogeneous functions.—Armand **Cahen**: Differential equations of the first order linear with respect to the function and the variable.—Renato **Caccioppoli**: Linear functionals.—A. **Tychonoff**: Abstract spaces.—N. **Lusin**: An arithmetical example of a function not forming part of the classification of M. René Baire.—Henri **Bénard**: The inexactitude, for real liquids, of the theoretical laws of Kármán relating to the stability of alternate vortices.—**Garsaux**: The provision of aeroplanes with oxygen. A device is described in which a specially constructed Dewar vessel containing liquid oxygen replaces the usual

cylinder of compressed oxygen: the weight of the apparatus is reduced to one-tenth of that when an oxygen cylinder is carried.—**Dumanois**: The retarded inflammation effect produced by antidetonants. The effect of the addition of such substances as lead tetraethyl to petrol is to retard ignition.—L. **Cagniard**: The use of the quadrant electrometer in high-frequency measurements of precision.—R. **Forrer**: The structure of the atomic magnet. The deformation of the multiplet by the field. The triplet in iron.—F. **Wolfers**: Interferences by diffusion.—R. de **Mallemann**: The dispersion of electrical double refraction of camphor. The specific double refraction of active camphor and of inactive camphor are sensibly identical. The dispersion is normal.—H. **Jedrzejowski**: The method of preparation of sources of RaB + RaC.—Pierre **Achalme** and Jacques **Achalme**: The influence of the viscosity on the specific rotatory power of certain active bodies. Two series of experiments are described, one in which the concentration was kept constant and the viscosity varied by the addition of solution of citric acid, the other in which the viscosity was kept constant and the concentration varied. In the first case the calculated specific rotatory power varied from 13·6 to 6·2; with concentration variable from 3·75 per cent. to 60 per cent. tartaric acid, viscosity constant, the calculated specific rotatory power was practically constant, 8·3 to 8·5. It is pointed out that this new fact of the effect of viscosity is of importance as affecting deductions on the molecular structure of active bodies.—Edmond **Bauer**: The electric structure of the molecules, particularly mesomorph bodies (anisotropic fluids).—P. **Surun**: The adsorption of some organic acids by two activated carbons of different origin. The data given are not in accord with the conclusions of Fromageot and Wurmser, which were based on experiments with Urbain carbon.—F. **Bourion** and E. **Rouyer**: Discussion of the results obtained in the quantitative study of the association of mercuric chloride. Reviewing the work of Linhart, Beckmann, together with the results of their own experiments, the authors conclude that there is equilibrium between simple and double molecules of mercuric chloride at 25° to 40° C. for concentrations not greater than 0·37 mol. There is equilibrium between simple and triple molecules at 100° C. and for concentrations higher than 0·5 mol.—E. **Sterkers** and R. **Bredeau**: Contribution to the study of reactions between solid bodies reduced to the colloidal state. Details of the preparation of calcium resinate in a colloidal mill. Zinc oleate and magnesium stearate can be prepared in a similar manner.—Ch. **Maurain**: The relations between terrestrial magnetic disturbances and solar activity.—Alb. **Frey**: The pigments of *Sterigmatocystis nigra*.—Ph. **Joyet-Lavergne**: The heterogamy of the spores of the horsetail and the characters of sexualisation of the cytoplasm.—R. **Combes** and R. **Echevin**: The variations in the organic matter, mineral matter, and especially calcium, in the leaves of trees during the autumnal yellowing.—H. **Prophète**: Contribution to the study of the waxes of flowers: rose wax. The results of a detailed chemical examination are given.—E. **Chemin**: The development of the spores of *Colaconema Bonnemaisoniae*.—Mme. L. **Randoine** and R. **Lecoq**: Do the water soluble vitamins (B) contained in beer yeast exist beforehand in the culture medium? It has been shown in an earlier communication that beer yeast and extracts of beer yeast, so far as concerns the water-soluble vitamins, have a higher value than that of other Saccharomyces or of other yeast extracts of different origin. It is now shown that the source of these vitamins is the malt extract used as the culture medium.—Jules **Amar**: Cellular pigments and physico-chemical actions.—Maurice **Piettre**: Some physical and chemical influences in hæmolysis by hæmolytic immunoserums.—J. **Benoit**: Differentiations, spontaneous and provoked, in the genital glands of the Gallinaceæ.—René **Fabre**: A spectrophotometric method for the study of hæmolysis.—L. **Mercier** and Raymond **Poisson**: Parasitic microsporidia of Mysis.—Edm. **Plantureux**: An antirabies vaccine containing formaldehyde.

CAPE TOWN.

Royal Society of South Africa, April 21.—C. von **Bonde**: The chorology of the S. African Heterosomata with some relative problems. The zoogeographical distribution of the S. African flat-fishes is dealt with. Part I. deals with ecology or environment of the species, and Part II. with chorology or their distribution in space. A comparison of the distribution of the Heterosomata with that of other marine faunas shows a remarkable agreement in the ratio of their occurrence in deep sea or in shallow water, the number of endemic species and the preponderance of east coast species.—A. **Ogg**: The structure of the sulphates.—W. A. **Humphrey**: (1) An occurrence of diamonds near Port Nolloth. This occurrence is the first to be discovered on the coastal belt south of the Orange River. The gravel is disposed in alternating layers of loose gravel and thin partings of hard conglomerate in which the constituents of the gravel are cemented together by a calcareous cement. This points to a seasonal deposition of gravel by a stream which was intermittent in its flow. The gravel shows signs of long-continued transport and the diamonds also show slight traces of wear. The source of the diamonds is probably somewhere within the basin of the Kammas River, with which the watercourse containing the gravel was once connected. The diamonds are very brilliant, white and well crystallised. (2) The changed conditions of Namaqualand. The river valleys of Little Bushmanland immediately south of the Orange River have been formed by the action of streams of considerable volume, which cut their way through masses of mountains during some far-distant pluvial period. The upper courses of the shorter tributaries of the Orange in this neighbourhood have been gradually filled up with drift sand which has encroached from the north and obliterated the stream valleys altogether; in some cases mountain ranges are in the process of being buried. The climate has changed from one with a comparatively heavy rainfall to its present semi-arid character. Similarly the Kammas River now no longer carries water to the sea, but is in course of filling up its own bed by its summer floods, which now spread the detritus from the Klipfontein Mountains in wide alluvial flats. This portion of Namaqualand represents an exceedingly old land surface in which valleys are gradually being filled up owing to a decrease in the humidity of the climate.—R. C. **McGaffin** and E. **Newbery**: Single potential of the copper electrode. Very varied results have been obtained by different workers for the single potential of copper in solutions of its salts. One, at least, of the main factors producing this variation is the formation of an insoluble film of basic salt by the action of the electrolyte upon the metallic copper. Attempts have been made to obtain concordant and trustworthy values (*a*) by careful cleaning of the electrode and measurement of the potential immediately after immersion, and (*b*) by retarding or if possible, preventing the formation of the film either by rapid rotation of the electrode or by violent stirring of the electrolyte.

Official Publications Received.

Journal of the College of Agriculture, Hokkaido Imperial University, Sapporo, Japan. Vol. 16, Part 1: (i) Über die qualitativen Methoden zur Methylpentosanbestimmung, von Kintaro Oshima und Kinsuke Kondo; (ii) Über die quantitative Bestimmung von Pentosan und Methylpentosan, von Kintaro Oshima und Kinsuke Kondo. Pp. 71. Vol. 17, Part 1: Studies in Plasmopara Halstedii, II. By Prof. Makoto Nishimura. Pp. 61+5 plates. Vol. 18, Part 1: On the Five Species of Dendrolimus injurious to Conifers in Japan, with their Parasitic and Predaceous Insects. By Prof. S. Matsumura. Pp. 42+5 plates. (Tokyo: Maruzen Co., Ltd.)

Proceedings of the Geologists' Association. Edited by A. K. Wells. Vol. 37, Part 2, June 25th. Pp. 117-250. (London: Edward Stanford, Ltd.) 5*s*.

Royal College of Surgeons of England. Annual Report on the Museum, by the Conservator, June 17th, 1926. Pp. 24. (London.)

Canada Department of Mines: Mines Branch. Investigations of Mineral Resources and the Mining Industry, 1924 (No. 642.) Pp. ii+118+5 plates. Investigations in Ore Dressing and Metallurgy (Testing and Research Laboratories), 1924. (No 643.) Pp. 115. Investigations of Fuels and Fuel Testing (Testing and Research Laboratories), 1924. (No. 644.) Pp ii+81+4 plates. (Ottawa: F. A. Acland)

Union of South Africa: Department of Agriculture. Science Bulletin No. 47. Physical and Chemical Analyses of Papers employed for Wrapping Fruit. By Dr. Francois J. de Villiers. Pp. 19. (Pretoria: Government Printing and Stationery Office)

Bulletin International de l'Academie Polonaise des Sciences et des Lettres: Classe des Sciences mathematiques et naturelles. Série B: Sciences naturelles. No. 3-4B, Mars-Avril, 1925. Pp. 277-508+planches 15-23. 4.50 zł. No 5-6B, Mai Juin, 1925. Pp. 509-622+planches 24 32. No. 7B, Juillet, 1925. Pp. 623-727+planches 33 36 No. 8B, Octobre, 1925. Pp.729-800+planches 37-48. Serie A: Sciences mathematiques. No. 8-10A, Octobre-Decembre, 1925. Pp 259-375+planches 3-9. No. 1-2A, Janvier-Fevrier, 1926. Pp. 101 No. 3-4A, Mars-Avril, 1926. Pp. 103-132. (Cracovie: Gebethner et Wolff.)

The Institute of Chemistry of Great Britain and Ireland. Register of Fellows, Associates and Students, corrected to 31st March 1926. Pp 352. (London.)

Bishop's Stortford College. Report of the Proceedings of the Natural History Society, 1925. Pp. 21. (Bishop's Stortford.)

Results of Meteorological Observations made at the Radcliffe Observatory, Oxford, in the Five Years 1921-1925. Vol. 54. Pp. xvi+101. (London: Oxford University Press.)

Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia. Jaarverslag 1925 Pp. 24 (Weltevreden: Landsdrukkerij.)

Memoirs of the Department of Agriculture in India. Botanical Series, Vol. 14, No. 2: Studies in Gujarat Cottons, Part 3 The Wagad Cotton of Upper Gujarat, Kathiawad and Kutch By Maganlal L. Patel and D. P. Mankad. Pp. iv+59-112+3 plates. (Calcutta: Government of India Central Publication Branch) 1.4 rupees; 2*s*. 3*d*.

The Kent Incorporated Society for Promoting Experiments in Horticulture. Annual Report (Thirteenth Year). I: General, East Malling Research Station, 1st January 1925 to 31st December 1925. Pp. 100. (East Malling) 2*s*. 3*d*.

Board of Education. Syllabus of the Science Scholarships Examination, 1927. Pp. 24. (London: H.M. Stationery Office) 4*d*. net.

Subject Index of the *Transactions of the Optical Society*, Vols. 1-25. By Prof. A F. C. Pollard. Pp. iv+89. (London. Optical Society, Imperial College of Science.)

The Decimal Bibliographical Classification of the Institut International de Bibliographie. Partly translated for the Formation and Use of a Universal Bibliographical Repertory concerning Optics, Light and cognate Subjects. By Prof. A F C. Pollard. Pp. viii+109. (London: Optical Society, Imperial College of Science.)

The Midland Agricultural and Dairy College, Sutton Bonington. Loughborough. Bulletin No. 9: County and Inter-County Clean Milk Competitions, organised by the College and the County Agricultural Education Authorities; Report on the Inter County Competition, 1925-26. Pp. 12. (Loughborough.)

Philosophical Transactions of the Royal Society of London. Series A, Vol. 226: The Behaviour of Single Crystals of Aluminium under Static and Repeated Stresses. By H. J. Gough, Dr. D. Hanson and S. J. Wright. Pp. 30+3 plates. (London: Harrison and Sons, Ltd.)

Zoologica: Scientific Contributions of the New York Zoological Society. Vol. 6, No. 1: Studies of a Tropical Jungle, One Quarter of a Square Mile of Jungle at Kartabo, British Guiana. By William Beebe. (Department of Tropical Research, Contribution No. 190) Pp. 193. (New York.) 1 dollar.

Scientific Papers of the Institute of Physical and Chemical Research. Nos. 57-58: On the Plasticity of Metals, Part 1, by Hikoroku Shoji; On the Plasticity of Metals at High Temperatures, Part 2, by Hikoroku Shōji and Yoshio Mashiyama. Pp. 189-206. 25 sen No. 59: Über die Konstitution der durch Hydrolyse von Rohoryzanin entstehenden β-Saure (Dioxychinolin-Carbonsaure) Von Yoshikazu Sahashi. Pp. 207-234. 30 sen. No. 60: The Influence of Cholesterol upon the Reproductive Potency of White Rats By Umetaro Suzuki and Nabetaro Hashimoto. Pp. 235-256. 25 sen. No. 61: About the Transference of Active States and the Mechanism of Catalytic Action. By Susumu Miyamoto. Pp. 257-262. 15 sen. No. 62: Analysis of the Alkali Group. By Sunao Ato and Isaburo Wada. Pp. 263-294. 35 sen. (Tokyo.)

New York Zoological Society. Report of the Director of the Aquarium. (Reprinted from the Thirtieth Annual Report of the New York Zoological Society.) Pp. 14. (New York City.)

Department of Commerce: Bureau of Standards. Scientific Papers of the Bureau of Standards. No. 523: Wind Pressures on Structures. Part 1: General Discussion on Wind Pressure Data; Part 2: Distribution of Pressure over a Model of a Tall Building By Hugh L. Dryden and George C. Hill. Pp. 697-732. 20 cents. No. 524: Measurements on the Thermal Expansion of Fused Silica. By Wilmer Souder and Peter Hidnert. Pp. 23. 10 cents. No. 526: Transmission and Absorption of Sound by some Building Materials. By E. A. Eckhardt and V. L. Chrisler. Pp. 37-63. 15 cents. (Washington, D.C.: Government Printing Office.)

Annals of the Natal Museum. Edited by Dr. Ernest Warren. Vol. 5, Part 3, May. Pp. 235-448+plates 15-25. (London: Adlard and Son and West Newman, Ltd.) 17*s*. 6*d*. net.

Edinburgh and East of Scotland College of Agriculture. New Series, No. 1: A Pure Milk Supply. By A. Cunningham and T. Gibson. Pp. 21. (Edinburgh.)

Proceedings of the United States National Museum. Vol. 68, Art. 25: Amphipods of the Family *Bateidae* in the Collection of the United States National Museum. By Clarence R. Shoemaker. (No. 2626.) Pp. 26. Vol. 69, Art. 1: A new Species of Fluke, *Parametorchis noveboracensis*, from the Cat in the United States. By See-Lu Hung. Pp. 2. (Washington, D.C.: Government Printing Office.)

The Physical Society of London. Proceedings, Vol. 38, Part 4, June 15. Pp 277-336. (London: Fleetway Press, Ltd.) 6*s*. net.

Memoirs of the Department of Agriculture in India. Chemical Series, Vol. 8, No. 9: Nutrients required for Milk Production with Indian Foodstuffs. By F. J. Worth, Asst.-Prof. Labh Singh and S. M. Husain. Pp. 153-187. (Calcutta: Government of India Central Publication Branch.) 14 annas; 1*s*. 6*d*.

Government of Madras: Local Self-Government Department (Public Health). Report of the Chemical Examiner's Department for the Year 1925. Pp 13. (Madras: Government Press)

Report of the Department of Industries, Madras, for the Year ended 31st March 1925. Pp v+102. (Madras: Government Press) 6 annas.

Meddelanden från Statens Skogsforsoksanstalt. Hafte 22, Nr. 3: Till Kottklangningens teori och praxis (Zur Theorie und Praxis des Klengprozesses). Av Lars-Gunnar Romell. Pp. 125-144. Hafte 22, Nr. 4: Tillvaxtprocentens Beraknande (The Calculation of the Increment percent with the Method of Compound Interest). Av Sven Petrini. Pp. 145-168. Hafte 22, Nr. 5: Studier over Barrskogens Humustacke, dess Egenskaper och Beroende av Skogsvården (Studien uber die Humusdecke des Nadelwaldes, ihre Eigenschaften und deren Abhandigkeit vom Waldbau). Av Henrik Hesselman. Pp. 169-552. Hafte 22, Nr. 6: Om Uppskattningen på Forsoksparkerna, av Sven Petrini, Redogorelse for Verksamheten vid Statens Skogsforsoksanstalt under år 1925. Pp. 553-590. (Stockholm: Centraltryckeriet.)

Diary of Societies.

AUGUST 4 TO 11.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (at Oxford).

Wednesday, August 4 (in Sheldonian Theatre), at 8.30 P.M.—H.R.H. The Prince of Wales: Presidential Address.

Thursday, August 5.—At 10 A.M.—Addresses by Sectional Presidents: B.- Prof. J. F. Thorpe, F.R.S.: The Scope of Organic Chemistry.—C. —Prof. S. H. Reynolds: Progress in the Study of the Lower Carboniferous (Avonian) Rocks of England and Wales.—F. —Sir Josiah Stamp: Inheritance as an Economic Factor.—K —Prof. F O. Bower. 1860-1894-1926.

At 11 A.M.—Addresses by Sectional Presidents: E. Hon. W. Ormsby-Gore: The Economic Development of Africa and its effect on the Native Population.—I.—Prof J. B. Leathes: Function and Design.—Discussion (Section M): Cultivation Methods.

At 2.—Conference of Delegates of Corresponding Societies.—Sir John Russell: Regional Survey (Presidential Address).

At 2.15.—Dr. F. A. Dixey: Recent Criticisms of the Theory of Mimicry (Lecture).

At 2.30.—Discussion (Sections E, H): The Effect on African Native Races of Contact with European Civilisation.—Discussion (Section M): Soil Classification.

At 5.—Discussion: (Sections L, M): Educational Training for Overseas Life.

Friday, August 6.- At 10 A.M.—Addresses by Sectional Presidents: G.—Sir John Snell: The Present and Future Development of Electricity Supply—L.—Sir Thomas Holland. Discussion (Section C). Problems of the Thames Gravels.—Discussion (Section M). Agricultural Education.

At 11 A.M.—Discussion (Section L): Scholarships.

At 11.30 A.M.—Addresses by Sectional Presidents: D.—Prof. J. Graham Kerr: Biology and the Training of the Citizen.—J.—Dr J. Drever: Psychological Aspects of our Penal System.—Discussion (Section K): Sex Determination in Plants.

At 2.30.—Discussion (Section I): The Relationship of Vitamin B to Bios.—Discussion (Section L): The Cinema in Education.

At 3-15.—Discussion (Section I): The Meaning of the Symptoms of Beri-beri.

At 3-30.—Discussion (Section L): Wireless in Education.

At 8.—Prof. A. S. Eddington: Stars and Atoms (Evening Discourse).

Monday, August 9.—At 10 A.M.—Addresses by Sectional Presidents: A. —Prof. A. Fowler. The Analysis of Spectra.—H.—Prof. H. J. Fleure: The Regional Balance of Racial Evolution.—M.—Sir Daniel Hall: The Limits of Agricultural Expansion.—Discussion (Section B): Tautomerism.—Discussion (Section L). Recent Advances in Educational Science.

At 11 A.M.—Discussion (Section K): Vegetative Propagation.—Discussion (Section D): The Training of a Zoologist.

At 2.—Discussion (Sections D, H, J): Heredity in its Physical and Mental Aspects.

At 8.—Prof. H. F. Osborn: Discoveries in the Gobi Desert by the American Museum Expeditions (Evening Discourse).

Tuesday, August 10.—At 10 A.M.—Prof. J. S. Huxley. The Study of Growth and its bearings upon Morphology (Lecture).—Discussion (Section L). The Public School System.

At 11 A.M.—Discussion (Sections C, D, K): The Conception of a Species.

At 11.30 A.M.—Discussion (Section M): The Feeding of the Dairy Cow.

At 12 noon.—(Section I) by Dr. J. S. Haldane: Acclimatisation to High Altitudes (Lecture).

At 2.—Conference of Delegates of Corresponding Societies.

At 2.30.—(Section J) by Miss W. Spielman: Recent Progress in Vocational Selection (Lecture).

At 5.—Sir F. Keeble: The Nervous System of Plants (Lecture).

Wednesday, August 11.—At 11 A.M.—Discussion (Section E): Regional Work in Geography.

At 12 noon.—Concluding General Meeting.

SATURDAY, AUGUST 7, 1926.

CONTENTS.

The State and Science.

IN electing the Heir to the Throne to fill its highest office, the British Association has honoured both science and itself. Since the Prince Consort filled this position in 1859, no member of the Royal Family has presided at its functions, and in succeeding his great-grandfather, H.R.H. the Prince of Wales has followed worthily in the footsteps of one who revealed an extraordinary insight into the possibilities of science, and initiated proposals that have led not only to the wide dissemination of scientific knowledge, but also to the harmonious co-operation of Science and the State.

The British Association has long been regarded as the mother of scientific parliaments, among the most important duties of which is that of bringing home to our people the significance and value of science to human life. No more effective spokesman could have been chosen than His Royal Highness, who, by virtue of his great experience as a traveller and interest in world-affairs, and of his immense popularity among all classes of the population, is pre-eminently qualified to convey the message of science to the nation and to the Empire. The onlooker, he says, sees a great deal of the game, and his experiences of things military and naval, his contacts with industry, education, public health, land-settlement, agriculture, transport, and housing, have convinced him that the future of civilisation lies "along a road of which the foundations have been laid by scientific thought and research." He has also come to realise that the future solution of practically all our industrial and social difficulties will only be found by scientific methods.

However divergent men's views may be on the course of human progress, whether it is rectilinear, or gyratory with frequent interruptions (like the recent traffic in Piccadilly Circus), the most pessimistic will admit that the thoughts, interests and achievements of men have appreciably expanded within modern times, and that this development has been attended by a noticeable growth in the spirit of toleration. Our universities are now open to all classes, creeds, and nationalities; the social 'cat' can not only look at the social 'king,' but rub shoulders with him on the playing field and at charitable functions; we no longer consign to the stake those who practise the profession of necromancy, or to the gallows those who unlawfully prey upon their fellow-citizens: instead, we give them 'space' in our popular newspapers, and leave them to the verdict of 'time.' This unfolding of the spirit of toleration is especially marked in the attitude of conservative interests towards science, and the Prince is very happy in his allusion to the Oxford Meeting of the British Association in 1832, when there was strong opposition

to conferring honorary degrees on such distinguished men of science as Brewster, Robert Brown, Dalton, and Faraday, whom Keble stigmatised as a "hodge-podge of philosophers"; and in his reference to the memorable meeting in 1860 when Bishop Wilberforce, at his famous encounter with Huxley, displayed an attitude of mind toward science that is rarely found nowadays, although, as Tennessee has taught us, it is not yet quite extinct. Such times are happily past, and even our most ancient and orthodox institutions are doing their best to march to the syncopated strains of modern civilisation. We must not, however, forget that feeling of 'dumb hostility' toward science and its works, referred to by Prof. Lamb in his presidential address last year, and again by the Prince on the present occasion; or the even more blighting feeling of apathy which still stalks in the land. Both these negative forces are the consequences of that ignorance and lack of imagination which instigated Voltaire to remark that although we had a hundred different religions, we had only one way of cooking a potato.

The history of the relations between science and the State in Great Britain, which is one of the principal themes of the presidential address, was sketched with a masterly hand, and nothing in it is more remarkable than the long period of delay—more than eighty years—which elapsed between the conception of a State department of science and its realisation when the Department of Scientific and Industrial Research was established during the late War. The time-lag between thinking and doing is ascribed by the Prince to lack of prevision of successive Governments, and to mutual distrust between science and the State; to these causes we would add ignorance of science and its methods, and the conservative attitude of the governing classes toward any disciplines which might compete with the study of the humanities and with orthodox religion. Many of us can well remember the bitter controversies which took place during the latter part of the last century between the respective champions of individualism and collectivism, and whilst the contention of the former that the genius of our people is ill-adapted to wholesale measures of nationalisation or widespread State control, is still held by the majority, it is evident that the ultra-individualism advocated by J. S. Mill, Herbert Spencer, and others is equally unsuitable as a practical creed. At any rate, time has largely solved the problem by the parliamentary method of compromise, and if we are not 'all socialists now,' we recognise that in certain matters affecting the welfare, and even the existence of our people, there is a legitimate field of State intervention; not necessarily for the purpose of assuming control, but rather for that of rendering assistance and giving advice.

Opinions will, of course, vary concerning the nature and extent of the fields into which the State can usefully penetrate. Those leaders of modern thought who are not obsessed by the mechanical and material aspects of Western civilisation, conceive progress to lie in a sense of values, and the majority of them admit that the cultivation of science, the broad and imaginative outlook which that cultivation engenders, and the application of scientific discoveries to human ends, are among the things that really matter to-day. Security in time of war, industrial progress in time of peace, education and national health at all times, cannot be left entirely to individual effort and initiative; and the only question that arises is the nature and range of the help which the State should give. In this connexion, the views recently expressed by the Earl of Balfour to the Society of Chemical Industry, which are evidently the views of the Department of Scientific and Industrial Research, over which he presides, are of interest. Apart from allocating grants to universities and the Royal Society, Lord Balfour holds that the State should not concern itself directly with promoting or assisting fundamental research work. Nor should it travel to the other end of the scale by finding capital for building factories and acquiring markets. Its legitimate sphere lies in helping to bridge the gap between laboratory experimentation and full-scale industrial operation, and in maintaining institutions like the National Physical Laboratory and the Fuel Research Station which, among other duties, pursue investigations of fundamental problems that are common to many industries, and therefore of great national importance.

In the recent attitude of the State toward science, the Prince discerns "a definite step in human progress," which is both novel and teeming with possibilities for Great Britain, the Empire, and the relations subsisting between them. Few, if any, of us know as much about the conditions in, and the needs of, our great overseas dominions as does the Prince; and none can speak with greater prestige. His remarks on the importance of extending knowledge of our overseas territories, on the value of co-ordinating the results of research work throughout the Empire, and on the good that results from personal contact between scientific workers from its various parts, require no emphasis from us; but we would point out that much as men of science may strive to serve the needs of Empire in the manner indicated, their services can only be small compared with those rendered by H.M. the King and H.R.H. the Prince of Wales, who, by their repeated visits to the Dominions, have strengthened beyond measure the natural ties of kinship that attach the motherland to her children beyond the seas.

Bacteriophage.

The Bacteriophage and its Behaviour. By Dr. F. d'Herelle. Translated by Dr. George H. Smith. Pp. xiv+629. (Baltimore, Md.: Williams and Wilkins Co.; London: Baillière, Tindall and Cox, 1926.) 36s. net.

AN indication of the appeal that the subject of bacteriophage has made to the interest of bacteriologists is afforded by the fact that, in this second book of d'Herelle's, the bibliography contains more than six hundred papers, of which more than five hundred have appeared during the last five years. In taking up the book one has in mind not only the importance of the bacteriophage in relation to fundamental problems of bacteriology, but also that the author was the first to make extensive investigations on the subject, under this name, and to demonstrate the phenomena by the striking and easily learnt technique which made it at once widely known. From the beginning of his publications in 1917, he has maintained the view that the bacteriophage is a living nonvisible virus that exists as a parasite upon bacteria. All the facts discovered since that time have been interpreted by him on the basis of this hypothesis and, as was to have been expected, it is in the light of this interpretation that the book has been written.

All those who have worked at the bacteriophage are not, however, adherents to this view. The phenomena produced by the bacteriophage and such properties of the active principle (bacteriophage itself) as can be determined by controlled experiments, are generally accepted. But to many the significance of these facts is chiefly in their relation to the possibilities afforded for further investigation of the nature and causes of bacterial variation and further analysis of bacterial metabolism. To these fields bacteriophage has opened new and valuable approaches, none the less valuable because numerous scientific investigators are unable to accept the hypothesis of a living virus. Amongst other contributions to the discussion written with less advocacy of a particular point of view, those of Bordet (*Annales de l'Institut Pasteur*, 1925, 39, 717) and Otto and Munter (*Ergebnisse d. Hyg., Bakteriol., Immunitätsforsch., u. exp. Therapie*, 1923, 6, 1) may be noted. The book under discussion is more than a review of the subject, it is as well an argumentative exposition of the author's views of the nature of the bacteriophage, his interpretation of the phenomena produced by it and his claim to priority in its discovery.

The larger part of the introduction of thirty-four pages is taken up with mention of observations of others so far back as 1892, in which, in the light of present knowledge, bacteriophage may have played a part. In several instances it is impossible to be certain whether this is a correct surmise, but it appears highly probable that the irregular forms of colonies described by Gildemeister (1917) in cultures of *B. typhosus* and *B. coli* were the result of the action of bacteriophage. Gildemeister himself is of this opinion. Five pages are occupied with a detailed consideration of a paper by Twort (1915) which appeared two years before d'Herelle's first publication and of which he was at that time unaware. The contention is that the phenomena described by Twort were not due to bacteriophage, although this view is not held by most of those who have studied the question and written on it. Indeed, though the class of bacteria was different and the ease of demonstration was less, it is generally accepted that the main characters of the two phenomena are identical and that Twort recognised the essential facts though uncertain as to the interpretation. The point in continuing these arguments for priority is not clear. It seems quite certain that d'Herelle was not the first to observe the phenomena due to the action of what we now term 'bacteriophage,' but, on the other hand, no one wishes to detract from the work of d'Herelle, who was the first to make extensive systematic investigations in the subject, and was chiefly responsible for bringing it forcibly to the attention of the scientific world.

The book itself is divided into three parts: (1) The phenomenon of bacteriophagy, (2) the bacteriophage, (3) the behaviour of the bacteriophage protobe. A lengthy discussion of these matters would lead one into highly technical fields of bacteriology into which it is not possible to enter here or necessary for those who are acquainted with the subject. For those who may wish to inquire further, d'Herelle's book or the reviews that have been mentioned will be of value.

In general terms the phenomenon of bacteriophagy consists of bacterial lysis transmissible in series. If one puts a small amount of 'bacteriophage' with a culture of a susceptible bacterium in a liquid medium, in the course of a few hours the turbidity of the culture decreases. Not all the bacteria are destroyed, however, and from the lysed culture, subcultures can be obtained of bacteria that resist lysis when exposed again in a similar way to bacteriophage. If the lysed culture be filtered through a Chamberland or similar filter, and all the bacteria removed, the filtrate contains a much greater amount of bacteriophage than was originally put in; the increase may be as much as ten thousand times in the course of six or eight hours. This process can be repeated indefinitely, the bacteriophage increasing in association with living susceptible bacteria upon which it has a lytic action. A similar lytic phenomenon may be obtained on solid media if

inoculation is made with a mixture of bacteriophage and susceptible bacteria. In place of normal bacterial growth there will develop, according to the conditions of the experiment, small clear areas devoid of growth, larger irregular areas, or almost complete absence of growth. If inoculation be made sparsely to allow isolated colonies of bacteria to be seen, some of them will be deformed by the absence of growth in part of the area they would normally have covered.

The bacteriophage is therefore an 'agent' or 'principle' that passes readily through filters that retain bacteria, that increases in association with living bacteria which are susceptible to lysis by it; its action upon a susceptible culture shows that all the organisms in the culture are not equally susceptible but that some are resistant, and if isolated are neither lysed by bacteriophage nor permit its increase in association with them.

The bacteriophage was first obtained by d'Herelle from the intestinal contents of patients recovering from dysentery. A Chamberland candle filtrate of a culture of intestinal contents added to a culture of a suitable organism produced clearing of the turbidity. Since then bacteriophage has been found widely distributed. It is present in the intestinal contents of healthy individuals and animals, in purulent discharges, in sewage, in river water, in soil, etc. In discussing the "ubiquity of the bacteriophage," p. 37, one would like to have seen set down along with these other sources the experiments of Bordet, who obtained bacteriophage from the exudate that formed after guineapigs were inoculated intraperitoneally with *B. coli.* One notes also that the experiments of Otto and Munter, who found that bacteriophage appeared spontaneously in some of the cultures in their laboratory, are dismissed with brevity. It is a question of fundamental importance whether the phenomena associated with bacteriophage are accentuations of processes that normally occur in bacteria. To dismiss these experiments with the statement that the strains from which bacteriophage had been directly derived had been "contaminated" with it from the time of their isolation, that is, that the bacteria and the bacteriophage virus had been isolated together from the body is, to say the least, a one-sided account and is, in fact, begging the question.

The explanations given of the phenomena of bacteriophagy are all based on the author's view that the bacteriophage is composed of individual living 'corpuscles.' For example, the mechanism of dissolution of a bacterial cell by bacteriophage as seen by the author under dark-ground illumination is summed up in a paragraph on p. 115, ". . . the single fact that the phenomenon of rupture is 'explosive' in nature shows that the bacteriophage corpuscle certainly penetrates to the interior of the bacterium, and that it is in this location that multiplication takes place." It is stated without any qualifications in the context, p. 18, that "the science of immunity has been held back for more than twenty years by the equivocation created in the subject by the term 'lysis,' which as a matter of fact has entirely lost its real significance." For this reason the destruction of the bacterial cell by bacteriophage is termed 'dissolution.'

One notes also the manner of mentioning the work of others whose results have been difficult to assimilate into the author's thesis. In particular, a sentence on p. 212, referring to one whose work is well known and accepted, which reads: "the contribution is absolutely incomprehensible, and it would seem that he has no idea of what in reality is the phenomenon of bacteriophagy," is an illustration of the author's attitude of mind.

The second part of the book deals with the characters of the bacteriophage itself. Its behaviour towards physical and chemical agents is discussed and a chapter is devoted to hypotheses concerning its nature, in which this aspect of the subject is extensively presented.

A point of some interest is the introduction of a new term to indicate a class or genus which is to include several of the so-called filterable viruses. The definition is as follows (p. 359):

"Up to the present time the infravisible agents of rabies, of variola, of vaccinia, of encephalitis lethargica, of the animal plagues and of the mosaics of plants, have been considered by the majority of biologists as living beings, but this point of view has been, however, disputed. Although the proof of the living nature of the bacteriophage is only valid for itself alone, it is none the less true that the living nature of all the beings which present the same characteristics is rendered the more probable by the facts disclosed in connexion with the bacteriophage. These infravisible beings have been termed 'invisible viruses,' 'ultraviruses,' 'ultramicrobes,' etc. This does not give them a name, for these terms are simply qualifying terms, designating their state of invisibility. In presenting the demonstration of the living nature of the bacteriophage I have proposed to designate this group of living 'micellar' beings by the name Protobes, a term which I have applied to the bacteriophage."

P. 357: "It is to this being, infravisible, parasite of bacteria, that I have given the name *Protobios bacteriophagus* (syn. *Bacteriophagum intestinale*) d'Herelle 1918."

The rôle of the bacteriophage in immunity is, broadly, the subject of the third part of the book. On p. 488 is found, "With plants, as with animals, antibacterial immunity is 'exogenous,' it is the bacterio-

phage protobe. This is a general fact throughout nature." If this were so one might expect important results from prophylactic immunisation with bacteriophage and its use in treatment. The final two chapters are taken up with these matters, but the enthusiasm of the author for his theme has produced an atmosphere of hope which will require much further work to be justified. Whatever view may be taken of the nature of the bacteriophage, it has undoubtedly a markedly destructive action on susceptible bacteria in the test-tube, but the principles involved in employing bacteriophage for prophylaxis or treatment of disease are as yet but little understood, and indeed further evidence is required to establish the reality of this branch of therapeutics.

The book, compared with the first one "Le bactériophage, son rôle dans l'immunité," 1921 (English translation, 1922), has increased in size. The presentation of almost every aspect of the subject has been expanded. A section on ultra-filtration is new. Much of the discussion concerning the various hypotheses that have been put forward to explain the nature of the bacteriophage is also new. This part of the subject has been given attention by most of those who have worked at bacteriophage. One is dealing with a filtrable, non-visible agent, possessing unique properties, of much interest in its relation, on one hand, to living viruses, and on the other, to bacterial and cellular lysins and to enzymes. In spite of much work, this exact relationship is still undetermined.

The Science of Photography.

(1) *The History of Three-Color Photography.* By E. J. Wall. Pp. x+747. (Boston, Mass.: American Photographic Publishing Co., 1925.) 15 dollars net.
(2) *Stereoscopic Photography: its Application to Science, Industry and Education.* By Arthur W. Judge. Pp. xv+240. (London: Chapman and Hall, Ltd., 1926.) 15*s.* net.
(3) *Die photographisch-chemische Industrie: die Erzeugung und Verarbeitung photographisch-chemischer Präparate.* (Technische Fortschrittsberichte, Fortschritte der chem. Technologie in Einzeldarstellungen, Band 10.) Pp. xvi+363. (Dresden und Leipzig: Theodor Steinkopff, 1926.) 18·50 gold marks.

PHOTOGRAPHY, in common with some other subjects, has the peculiarity of being both an art and a science. The manufacture of sensitive emulsions suitable for very variable requirements, the design of cameras and optical systems by the use of which the light impression is obtained on the sensitive film, and the processes of development, printing, etc., are essentially scientific, involving as they do chemical and physical problems which are often of a very complicated nature. On the other hand, photography is commonly spoken of as an art, and it may be said that, with few exceptions, the best exponents of the art know very little of the science underlying the use and practice thereof. Even in connexion with the scientific side, it is true to say that the present high standard which has been reached in the manufacture of plates, films, and papers, which may be used for an infinite variety of purposes and in all climes, is due to empiricism and experience having far outstripped scientific knowledge; this is also true of developers and development, toning, sensitising and de-sensitising dyes, etc. At the same time, it must be emphasised that since the investigation of the scientific foundations of photography was initiated by Hurter and Driffield, increasing attention has been paid to this branch of applied science, and the effect of the results obtained has been very marked on the progress of manufacture and on the applications of photography.

In two of the branches of photography dealt with by the works under review, namely, colour photography and stereoscopic photography, it is self-evident that the scientific basis is all-important, and that any advances made must be dependent on progress made in our knowledge of colour and stereoscopy. At the same time, the necessity of satisfying artistic requirements has had a great influence in directing the course of scientific inquiry. The third book, "Die Photographisch-chemische Industrie," treats only of matters which are industrial and scientific in character.

(1) Mr. Wall has long been noted for his encyclopædic knowledge of the processes of photography, especially of colour photography, and it is not to be wondered at that he has produced a remarkable and unique book. It is the product of thirty years' study and search of the original literature of colour photography and allied subjects, and the author claims, with justification, that "there is no work in any language which has brought together a history and summary of colour photography comparable to this book." Reserving the Lippmann, Seebeck, and bleach-out processes and photo-mechanical reproduction for another volume, the attempt is made to record, even to the most minute detail, every step in the progress of colour photography of both still and moving subjects, from the earliest beginnings to the early part of 1925; detailed references to the original articles or patent specifications are given in every case. The first chapter gives the necessary "Historical and Theoretical Data," after which comes an extremely valuable chapter on colour filters and colour screens,

the use, preparation, and transmission factors of which are given in detail. In three succeeding chapters, still cameras and chromoscopes, bi-packs and tri-packs, and various optical devices are described. Colour sensitive plates, with the methods of sensitising and testing, de-sensitisation, and the preparation of photographic papers, are fully discussed and a list of sensitising dyes, together with their range of action, is given. Subtractive processes and screen plates are dealt with, each in five chapters, whilst other chapters give an account of three-colour transparencies, autochrome stereoscopy, dichromate printing, prismatic dispersion processes, etc. The chapter on colour kinematography is most valuable; this has necessitated a search of the patents of all countries, there being practically no literature on the subject.

The great value of this book lies in the fact that the practising photographer, the inventor, and the researcher will find therein complete records of what others have done; time will not be wasted in re-discovering ideas already known. In this respect it should be mentioned that numerous patents are reviewed which could not be found from the patent office indexes, as they are listed only under other classifications.

Very few errors and misprints have been noticed, but occasionally, as on pp. 55 and 544, the author's mathematical equations go wrong, although the right result is obtained in the end. It is stated that the edition is limited and the type will be distributed as soon as printing is completed, otherwise the reviewer would have suggested that the various and numerous data which are given in terms of the Fraunhofer lines should be expressed in wave-lengths in the next edition.

(2) On the Continent, stereoscopic photography seems to be practised much more than in England, and, for the most part, the literature has been chiefly in French and German. The appearance of an English book on the subject is therefore to be welcomed, not only because stereoscopic photography forms a fascinating hobby, but also because of the applications to which it is being put. The anaglyph is being utilised more and more for the stereoscopic illustration of commercial catalogues, books, and magazines.

The reader of the book will probably be surprised at the extensive applications of stereoscopy in science.

"By its aid the microscopist, for example, is able to observe stereoscopically and to photograph the minute solid objects revealed under his microscope, and eventually, in the stereo-photographs, to obtain permanent records of these objects in relief. The astronomer employs stereoscopic principles not only to detect the presence of faint stars and binaries, but also to show in realistic relief the features of the moon, comets, certain of the planets, and also the proper positions in space of stars of greater magnitudes forming the constellations. The radiographer is enabled by stereoscopic X-ray pictures to locate exactly foreign bodies in the human system, to show the position of flaws, air-pockets, or defects in castings, metals, or other materials, and to reveal the internal structures of organic bodies and interiors of composite bodies and mechanisms."

It is becoming of increasing importance in aerial and land survey, and its possibilities in enabling the student to visualise complex diagrams and objects are being recognised more and more.

In order to maintain a popular as well as technical interest in stereoscopy, the theoretical and analytical sections have been reduced to the minimum proportions, but the treatment is sufficient for the end which the author has in view, namely, that of interesting both the advanced worker and the amateur. Stereoscopy with a single lens camera, the selection of stereoscopic cameras and accessories, the viewing of stereograms, photographic processes, and notes, etc., are all adequately described before the applications of stereoscopy are considered. For those who wish to pursue the subject there is an appendix giving a bibliography of the literature. There is no lack of illustrations, there being some 150 line and half-tone reproductions and 19 plates in stereoscopic pairs.

The author is to be congratulated on a book which will occupy a worthy position in English photographic literature.

(3) This book, as its title indicates, is mainly concerned with the manufacture of photographic material, and gives a literature summary covering the period from 1914 to the present time. There are four sections, which deal respectively with: (*a*) The manufacture and testing of photographic dry plates, (*b*) the manufacture and testing of films, (*c*) the manufacture and testing of photographic papers, and (*d*) the working of photographic materials. This last section occupies practically half of the book and deals with the testing of photographic materials and the usual operations of photography (exposure, development, etc.). Fundamental researches on the scientific basis of photography are not neglected, but are not dealt with in detail. The German aptitude for summarising literature is well in evidence, and if this book is used together with the various Reports on Photography which have been published by the Society of Chemical Industry, it will be invaluable to photographic workers, both those in the industry and in research laboratories.

There are occasional errors, and among these the names of English workers sometimes suffer considerably, as when "Fog" is written for "Toy."

T. S. P.

History and Evolution.

Theory of History. By Prof. Frederick J. Teggart. (Published on the Foundation established in Memory of Philip Hamilton McMillan of the Class of 1894, Yale College.) Pp. xix+231. (New Haven, Conn.: Yale University Press; London: Oxford University Press, 1925.) 14*s*. net.

PROF. TEGGART'S book is a useful and learned contribution to a very important contemporary discussion. What is the relation between historical method and the method in the natural sciences, and especially in that nearest to history, namely, biology? It would be difficult to find any statement so clear and pointed as Prof. Teggart's of the difference that has arisen, mainly in the last century and especially since Darwin, between what one may call the 'sociological' and the 'historical' school among the writers of history. Prof. Teggart states it clearly, truly, and forcibly, and traces it to its source; he gives apt and numerous quotations from representative thinkers; unfortunately, he does not work out his own solution in the same fulness. He points out the difficulties, but does not solve them: the solution, in fact, demands a prolonged and thorough philosophical treatment, far beyond the scope of his short essay, and still more of a shorter notice of it. However, we may be thankful to him for having cleared the ground, and await the more leisured cultivator who must come later.

To take two prominent names as representing the two philosophical poles in the discussion, Comte and Bergson: as Frenchmen they have the national gift of expressing logical extremes, though it would be easy in each case to quote amply from the author evidence that his own practice was not, and could not be, in accord with his own logical presumptions. Comte is fully, and on the whole justly, treated by Prof. Teggart as the most powerful voice in the nineteenth century in favour of the sociological, or generalising, view of history. That view maintains that in the limit, that is, if our knowledge were complete, and in proportion as our knowledge increases, we can formulate 'laws' for history and neglect particular events and personalities; that, in the limit, human history would become, like astronomy, a completely reasonable evolution of an idea, or set of ideas, which with adequate knowledge might always have been predicted beforehand as we predict the movements of the heavenly bodies. That is the extreme, logical or determinist point of view, and it was fortified in 1859 by Darwin's formulation of evolution as proceeding by an infinite and unceasing series of minute variations. Its extreme opposite can be found in M. Bergson's view that every human action is a new and creative thing, and that our actions become more perfectly human just in so far as they are free and undetermined by previous happenings. History, therefore, which is an account of human action, cannot be a science, because it deals with the particular and individual, whereas science is always making general conceptions from the recurrence of particulars. Prof. Teggart illustrates this attitude from the two leading thinkers in the nineteenth century who reacted against the generalising and intellectualist attitude in human affairs—Schopenhauer among philosophers and Ranke among historians. This part of his book is the most impressive.

Where is the plain man to take his stand, especially one who comes to history from the orderly discipline of the natural sciences? He will say, in the first place, that neither of the extreme philosophical points of view can be wholly true; he will deny, on one hand, that every human action or event can be properly treated as merely individual; he will be sure that there are, if not 'laws,' at least connexions, movements, and tendencies in history. On the other hand, he will be equally sure that exact formulation, as in the case of mathematics, or prediction, as in the case of astronomy, is out of the question in history or sociology. He will look in history for general similarities and general movements containing an infinite variety of individual difference and freedom of development. To reconcile this apparent contradiction is one of the greatest and noblest objects of human thought.

Two limited and definite suggestions may be made here, appropriate to Prof. Teggart's book. One is that he makes no allowance for the increasing importance of the history of thought in general history. This is the most characteristic and decisive thing in the history of history-writing in the nineteenth century. Whewell was its first exponent in Great Britain about a hundred years ago, one of the first exponents in the world of the history of science as a whole. This aspect of history has made increasing strides ever since, and has now several organs and a mass of literature in all leading educated communities in the world. Now in so far as we look on the history of scientific thought as a guiding thread in general history, so do we perceive an orderly advance and a community of mankind. Above all, it enables us to take a more decided line on the other and last point on which we will comment on Prof. Teggart. He ends his book by saying that the difficulty which he has been discussing will be largely solved "if we recognise the difference between a ***belief in progress*** and a ***belief in the possibility of progress***." The difference will not appear so great between the two attitudes if we reflect that a belief in the possibility of progress, that is, in the future, depends on the establishment, by history, of progress in the past: and, as

the progress of science is the most obvious and measurable thing in history, those, like Prof. Teggart, who would build their faith on the 'possibility' of progress in general, must turn to the annals of systematic and objective thought. F. S. MARVIN.

Our Bookshelf.

Essex: an Outline Scientific Survey; including Geology, Botany and Zoology. By Members of the Essex Field Club and others. Prepared on the Occasion of the Congress of the South-Eastern Union of Scientific Societies at Colchester. Edited by G. E. Hutchings. Pp. 133+4 plates. (Colchester: Benham and Co., Ltd., 1926.) 3*s.* net.

THIS "Outline Scientific Survey," published in connexion with the recent Congress of the South-Eastern Union of Scientific Societies, at Colchester, should prove of wide and permanent interest. Consisting of a series of articles by well-known field naturalists, it provides a detailed account of past researches into the geology, botany, entomology, ornithology, crustacea, etc., of Essex, summarising the great volume of work accomplished by the Essex Field Club during the forty-six years since the club was founded, and work done by earlier Essex naturalists.

Covering a wide field, the articles are necessarily condensed, and will appeal to scientific workers rather than to the general public. The value of this survey is enhanced by the bibliographical notes appended to each article, and by the geological sketch map of the county. A useful index of the survey is also provided.

Owing to limitations of time and space, omissions could scarcely be avoided. One finds in the survey no mention of the mammals, reptiles, and fishes of Essex. These have been fully dealt with by the late Dr. Laver, past president of the Essex Field Club, in a special memoir published by the Club, and also in a report upon Essex and Kent sea fishes, compiled by the late Mr. E. A. Fitch, also a past president of the Essex Field Club, collaborating with the late Dr. Murie, published by the Essex and Kent Sea Fishery Board. Another special memoir of the Essex Field Club deserved attention, namely, the very complete report upon the Essex earthquake, by Meldola and White; and it is surprising to find no reference to the historic and world-renowned 'native oyster'—a variety of the oyster confined to the estuary of the Thames. The oyster fisheries of Essex have certainly been protected for more than seven centuries, probably for more than a thousand years, and possibly from Roman times. As the partridge and pheasant, similarly protected, are always included in British bird lists, we should have expected the Thames Estuary variety of oyster to figure in a scientific survey of Essex. An exhaustive account of this fishery by a member of the Essex Field Club appears in the Essex "Victoria History," and later a pamphlet was published, compiled by the late Dr. Laver, who took a keen interest in this fishery. The small but interesting pyrites industry formerly on the Essex coast, an account of which (by a member of the Club) is included in the Essex "Victoria History," also deserved mention. These omissions could be remedied, in later editions or reprints of the survey, by a brief editorial note.

Monumenta Medica. Under the General Editorship of Henry E. Sigerist. 3: *The Earliest Printed Literature on Syphilis; being Ten Tractates from the Years 1495–1498.* In complete Facsimile, with an Introduction and other accessory material by Karl Sudhoff, adapted by Charles Singer. Pp. xlviii+352. (London: D. Stanton, 90 North Road, N.6; Florence: R. Lier and Co., 1925.) n.p.

OWING to rearrangements, incorporations, and other changes, this beautifully printed and illustrated work, which forms the third volume in the series of "Monumenta Medica," of which the second was reviewed by us some months previously (NATURE, December 5, 1925, p. 811), is, as Dr. Singer remarks in the preface, almost a new work rather than a translation. The writers whose works are reproduced in facsimile are Konrad Schelling of Heidelberg, physician to Philip, Elector to the Palatinate and friend of the humanist Jakob Wimpheling, Joseph Grünpeck of Burckhausen, himself a sufferer from the disease, Niccolo Leoniceno of Vicenza, whose pamphlet was published by the great humanist printer Aldus Manutius at Venice, Hans Widmann of Tübingen, Caspare Torrella of Valencia, who was physician to Pope Alexander VI. and treated his son Cæsar Borgia for syphilis, Corradino Gilino, who recommended the heroic treatment of application of a red-hot iron to the head for curing the salivation caused by mercurial inunctions, Bartholomæus Steber of Vienna, Natali Montesauro of Verona, the first to describe clearly the ostescopic pains of syphilis, and Antonio Scanaroli of Modena. Their contributions to the history of syphilis, while none of them is without considerable interest, are of very unequal value. With the exception of Grünpeck's pamphlet entitled "Ein Hübscher Tractat von dem Ursprung des bosen Franzos," all the tracts are written in Latin.

Prof. Sudhoff regards the work of Torella entitled "Tractatus cum consiliis contra pudendagram seu morbum gallicum," as the most valuable of all the tracts, inasmuch as it is the least prejudiced, the freshest, and the least academic. Perhaps the next most interesting pamphlet in this collection is that entitled "De pustulis et morbo qui vulgo mal de franzos appellatur" by Hans Widmann, who distinguishes the French disease from leprosy, holds the breath of the sufferers to be contagious, and regards the rashes and, above all, the affection of the mouth, as characteristic of the disease.

As Prof. Sudhoff points out in his foreword, the works reproduced will prove of interest not only to epidemiologists and medical historians, but also to students of the history of culture and the art of printing.

Dialogues in Limbo. By George Santayana. Pp. vii+193. (London: Constable and Co., Ltd., 1925.) 10*s.* 6*d.* net.

THE dialogue form enjoys a mild vogue among American philosophers, and it is hard to imagine any more brilliant exponent of it than Mr. Santayana. It expresses admirably the subtle irony of his delicately perceptive intelligence. Of the literary success of his experiment there is no question. Yet interpretation is hard, for, as in all living discussion, the emphasis shifts

and one cannot certainly infer what the message is. The scene is Limbo. The spirit of the earthbound stranger holds converse with the illustrious shades—Democritus, Aristippus, Alcibiades, Socrates and the rest—who manage to retain a stronger personal identity than even Mr. Broad's 'psychic factor' would explain; and much of their discourse is at variance with the 'Life of Reason.' For there, at all events, Mr. Santayana has declared himself on the side of reason, has shown how, from the raw material of human character, its diversity of impulse and of passion, reason has to create some kind of harmony; but here the issue is less certain.

Of all the shades, Democritus is endowed with the greatest power and energy of conviction; and he, as frank materialist, is clear enough that the life of reason is largely illusion, and that "the chief and most lasting illusion of the mind is the illusion of its own importance." True, the illusion is necessary and in its way beneficent; for the state of wisdom is "an evanescent madness when the dream still continues, but no longer deceives." Even Democritus, however, can scarce tell whether it is more important that the dream should continue or that it should not deceive. On one side, the practical business of life requires its endurance, since only so can we forbear the bewilderment of ultimate inquiry, and like Protagoras take the way of establishing, by the support of tradition and experience, a valid conventional distinction between sane beliefs and mad. Yet, when the deepest challenge comes, Democritus is impelled to the vow, "I will dismiss and expel every remnant of illusion, even in myself, in order that nothing of me may remain save the atoms that compose me"—truth before aught else. So, too, in a not dissimilar ethical discussion, the dialectic of Socrates can overthrow the vaguely emotional democratic theory of the stranger; but makes less headway against the stranger's version of the teaching of his prophet of human love and gentleness.

There is no finality here: no set conclusion, but a lively and sensitive handling of the issues, and a breathless brilliance of fine debate. H. J. W. H.

An Introduction to Historical Geology: with Special Reference to North America. By Prof. William J. Miller. Second edition. Pp. xvi + 399. (London: Chapman and Hall, Ltd., 1925.) 13*s.* 6*d.* net.

PROF. MILLER'S "Introduction to Historical Geology" is not quite so successful as his "Physical Geology," recently reviewed in these columns. The fundamental principles of stratigraphy and the organic inferences are carefully dealt with, and the book contains very useful summaries of Palæozoic and Mesozoic life-forms. Indeed, throughout the book the palæontology is well done. But physical history is especially emphasised, and yet here the treatment follows the conventional lines of older text-books and fails to include the results of much modern work. In dealing with geological time the author is particularly old-fashioned. He writes, "the Cambrian period represents a long time, the best estimates ranging from 2,000,000 to 3,000,000 years. . . . Though the succeeding periods were by no means equal in duration, the best estimates would make no one of them less than 1,000,000 years long." The term 'best' evidently applies to the old estimates of Walcott, and implies ignorance of, or indifference to, the magnificent work of Barrell in this field. More attention might also have been devoted to the palæographical researches of Schuchert, which reveal at least eighteen great marine transgressions over the North American continent. The book is well printed and illustrated, but reveals no originality of either point of view or treatment.

Sahara. By Angus Buchanan. Pp. xv + 301 + 78 plates. (London: John Murray, 1926.) 21*s.* net.

CAPT. BUCHANAN has added to his previous works on Africa another valuable book in which he shows his power of descriptive writing and his insight into the native mind. His journey on this occasion was across the Sahara from Kano by way of Ahaggar to Touggourt and Algiers. The main objects of his journey were to secure kinematograph films and make studies in natural history. Happily he avoids the monotonous iteration of daily marches and incidents of camp life, and succeeds in giving a series of vivid pictures of the Sahara, its animal life and its people. While the interest is mainly in natural history, there is a great deal of geographical value in the book. In fact, few volumes give better impressions of the vastness and solitude of the desert. It is a pity that the small map is wholly inadequate for a book of this importance.

Nature, Thought and Personal Experience. By Dr. W. Tudor Jones. Pp. xii + 182. (London: Williams and Norgate, Ltd., 1926.) 7*s.* 6*d.* net.

DR. TUDOR JONES has consciously or unconsciously come under the influence of the new doctrine which is being preached in science under the descriptive title emergence. The theory of emergent evolution is an attempt to interpret the process of the cosmos as a succession of 'levels,' each level being characterised by new properties which, though the outcome of the conditions of the previous level, could not be predicted from it. With his well-known zeal for the recognition of moral and religious values, Dr. Tudor Jones applies this as a rationale of the relation of Nature and thought in personal experience. Though dealing with values, he never loses touch with the actualities of positive science.

My Flight to the Cape and Back. By Alan J. Cobham. Pp. vi + 70. (London: A. and C. Black, Ltd., 1926.) 1*s.* 6*d.* net.

THIS small volume is a modestly told record of the great achievement of Mr. A. J. Cobham in flying from London to Cape Town and back last year. It was not a hurried flight, as lengthy halts were made at several places on the route via Italy, Greece, Egypt, the Nile, the Lake Plateau and Bulawayo, but it was most successful and singularly free from mishap. The reader may regret the lack of adventure, for Mr. Cobham does not even embroider his story, and makes slight of every incident. But the absence of sensation is a tribute to the skill of the pilot and the worth of his machine. There are several interesting aerial photographs.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Lightning.

IN a recent and very interesting article (*Proc. Roy. Soc.*, A, 111, 56-67, 1926, May 1), Dr. G. C. Simpson advances a theory of the method of advance of a lightning stroke. As he concludes that there can be no substantial stroke of negative charge, perhaps it would be better to say that he develops a theory of the advance of a positive stroke, meaning by this the advance of a stroke of positive charge. A short time ago, I proposed (*Journ. Franklin Inst*, **201**, 485-496, 1926, April) a theory of the advance of a negative stroke. As the two theories are apparently conflicting, it is desirable to consider the conflict in order to see in how far it is real, and in how far the theories are merely complements one of the other.

Dr. Simpson regards the advance of the stroke as dependent upon the flight of free electrons In this, the two theories agree. He says nothing about the source of the electrons, but I imagine that no serious objection will be raised to the assumption that essentially all result from collisions of rapidly moving electrons, or ions, with molecules. He pictures the positive stroke as the advance of a positively charged tongue extending from the cloud, the advance arising from a continuous sucking of electrons from an ionised region immediately ahead of the tip of the tongue, the branches of the stroke being formed in the same manner at places determined by the irregularities of the field.

But what ionises these regions ? If the field at the tip of the tongue is sufficiently intense, the positive ions in it will be driven forward with such velocity that they will ionise the air. In such fields, the electrons so liberated will be very effective ionisers, thus increasing the supply of electrons and of positive ions. Thus the tongue will advance as a result of the repulsion of its constituent ions, and the progress will be continuous so long as the field at the tip remains sufficiently intense If we regard the tip of the tongue as a region somewhat to the rear of the advance ions which produce the ionisation, this picture accords closely with what seems to be Dr Simpson's concept. Under favourable conditions, such an advance could certainly occur. But in order for branches to be formed by such a process, not only must the field be irregular, but also along the main spark the several regions of maximum lateral intensity must be small and quite definitely circumscribed.

It is difficult to believe that the field can have the very fine-grained structure necessary for the wonderfully rich development of branches which is frequently observed This seems to call for another explanation. Our present conceptions of the nature of the discharge of electricity through gases suggests that the branches are not outgrowths from the trunk, but ingrowths to it. In the region within which the intensity of the field is sufficient to confer upon a free electron the ionising velocity, there occurs, here and there, a stray free electron Each of these is sucked in by the field, and ionises the air along its path, and the electrons so freed join it in its flight. Thus each gives rise to an increasing swarm of electrons flying up the field. The number and distribution of the branches are determined, not by the irregularities of the field, but by the number and distribution of chance electrons. The trails of the electrons are positively charged; they are exactly similar to the tongue pictured by Dr. Simpson, but each arises from a negative stroke to the positive region, rather than as a positive stroke from that region. The trails extend the field, and may pick up other stray electrons which otherwise would not have been caught. Thus a branch may grow in length and may branch. In the same manner the main discharge, or tongue, may advance, not by pushing forward, but by successive negative strokes towards it. A much weaker field will suffice for this type of advance than for the other.

Even when there is ionisation by positive ions, there must in any actual case be ionisation by stray electrons also, and as the mobility of electrons far exceeds that of positive ions, it would seem that the path would be blazed by them rather than by the positive ions, and that the latter would merely enhance the charge of the blazed path and the current along it. In this case the path of the advance is determined by a succession of negative strokes, each starting from a stray electron at a distance from the tip of the tongue; and the effects of such a stroke will be similar to those produced by what I called an upward stroke of negative charge.

There seems to be no reason for doubting that a positively charged tongue, formed in either manner, might reach down into a region in which the field prior to its advent was very weak, or even adverse to the advance.

Dr. Simpson considers that the advance of a negatively charged tongue is impossible, because the mutual repulsion of the electrons would cause a continued broadening of the tip This, however, depends upon the conditions of the problem If the tongue consisted of a swarm of free electrons, and if it was not subjected to an external field, then it would certainly broaden out But if it is subjected to a longitudinal field which is intense as compared with the cross-field due to the mutual repulsion of its constituent electrons, then the paths of the electrons will make only small angles with the axis of the tongue, and at the tip the path will be axial. In this case, the growth will be axial, but there will be a lateral wastage. The electrons passing away from the axis will soon reach a field which is so weak that they lose their ionising power, become ions, and cease to migrate with significant velocity.

There are also other difficulties It is not clear how a negative tongue reaching some distance from a cloud can ever form if the field is not sufficiently intense to confer upon the positive residues an ionising velocity. If the positive residues take no active part in the ionisation, then as stray electrons near the cloud are driven away by the field, ionising the air as they go, they form a swarm of electrons which is separated from the cloud by a trail of positive residues. What is formed is not a tongue of negative ions reaching from the cloud, but a flying swarm, or dart, of electrons which is cut off from the cloud. On the other hand, if the field near the cloud is so intense that the positive residues acquire the ionising velocity, then they will serve as a continuing source of electrons, and a long tongue, or dart, of electrons will form Being subjected to the field of the dart as well as to that of the cloud, the forward portion of such a dart may acquire a tremendous velocity; this will facilitate its passage, and also reduce the lateral wastage But still there is no long tongue of negative ions extending from the cloud; there is nothing analogous to the tongue of positive ions, and apparently there cannot be. But there will be high-speed darts of free electrons. These and their highly ionised trails are essential features of the picture which

I proposed for the negative stroke. Many characteristics of lightning strokes can be satisfactorily correlated by means of such a concept.

With reference to the object struck, there are probably two main types of strokes: (1) The positive stroke, in which a positively charged tongue of ionised air extends from the cloud to the object; (2) the negative stroke by an electronic dart, of which the highly ionised trail extends from the cloud to the object. In general, the initial effects of the second will be more abrupt, more deep-seated, and more rending than those of the first.

The positive tongue theory advanced by Dr. Simpson and the electronic dart theory proposed by myself are not conflicting, but mutually complementary. The apparent conflicts, in so far as they are not a mere matter of words, arose solely from misconceptions, on one side or the other, regarding the completeness of the picture being presented.

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Washington, D.C.,
June 9.

IN the paper referred to by Dr. Dorsey, I discussed how a lightning flash is propagated from a positively charged cloud. In that paper, of set purpose, I did not discuss how the ionisation takes place, relying on the simple statement that ionisation does take place when and where the field exceeds a certain unspecified minimum value. I did this to avoid discussion of details which were unessential to the main purpose of the paper. But as Dr. Dorsey now raises these questions they must be considered, although the correspondence columns of NATURE are not appropriate for the full discussion which they really require. I must therefore be content with a few remarks on his main points.

There can be little doubt that free negative electrons which are always present in the atmosphere play some part in the ionisation accompanying a lightning discharge; but all the evidence, in particular the sharp boundary of the discharge channel, points to this action being confined to the immediate neighbourhood of the channel. In fact there is reason to believe that it is confined to the small region at the extreme tip of the advancing channel, where alone, in my opinion, the field is sufficiently strong to cause appreciable ionisation.

With regard to branching, Dr. Dorsey says: "Our present conceptions of the nature of the discharge of electricity through gases suggests that the branches are not outgrowths from the trunk, but ingrowths to it." I wonder to whom the word "our" in this sentence refers, for personally I cannot form any such conception. To me it is quite inconceivable that the branches grow from their tips inwards, finally uniting to form the trunk. This would mean that the electrical discharge starts in the weakest part of the field and not, as one would expect, where the field is strongest, near to the charged cloud.

The second half of Dr. Dorsey's letter is of more fundamental importance. He describes darts of negative electrons which are shot out of negatively charged clouds. It is not easy to understand Dr. Dorsey's ideas from this letter alone; but by reading his other publications I have come to the conclusion that his darts are very little different from the negative discharges which I considered and rejected in my Royal Society paper. I did not consider that such negative discharges are impossible "because the mutual repulsion of the electrons would cause a continued broadening of the tip," as stated by Dr. Dorsey. As a matter of fact, the mutual repulsion of the electrons never entered my head when writing the paper, for any such repulsion is infinitesimal in comparison with the fields which exist where ionisation takes place. The negative electrons would spread out at the tip of a negative discharge, if such could form, not because of mutual repulsion, but because the field under which the electrons move is divergent at the tip.

If it is granted that ionisation takes place where the field is a maximum, then the lines of force must diverge from that maximum. It is because the electrons move inwards for a positive discharge and outwards for a negative discharge that the former is possible and the latter impossible. It is this divergence of the field of force which would prevent the formation and existence of the darts imagined by Dr. Dorsey.

G. C. SIMPSON.

Butterfly Migration.

IN NATURE, September 5, 1925, Dr. E. P. Felt, State Entomologist of New York, in an article on the "Dispersal of Butterflies and Other Insects," said, "It is our belief that determinate flight is a comparatively small factor in promoting the spread of insects, and that in many cases this is accomplished largely by drifting with the wind, . . . There are a number of records of apparently determinate movement by butterflies, . . . These cases may represent a true migration, though this is scarcely established by available data."

In a later article, "Physical Basis of Insect Drift," NATURE, May 29, 1926, Dr. Felt continued the discussion and said, "the general tendency has been to explain any widespread movement as a migration, that is, a somewhat determinate or purposive movement by hosts of insects. This attitude is due in part to our very limited knowledge as to the movements of the upper air currents, . . . Turning to the western hemisphere, there are several records of enormous swarms of this butterfly, *Vanessa cardui*, being observed in apparent migration in southern California in 1924 and 1926, the movement being from the south-east to the north-west. One of the observers suggests that the source or the origin was either the foothills of the Sierras or the Sierras proper. There is a possibility that these swarms originated at a considerably greater distance. They may have been carried into the upper air in regions bordering desert areas considerably farther south or south-east, in much the same way as suggested for this insect in the eastern hemisphere, since we have in both extensive desert areas constantly producing convectional currents, and after a certain altitude is attained, the probabilities of extensive drift are certainly excellent."

Doubtless the movements of some insect swarms cannot be explained without the help of the winds. But what is needed, at least in the case of the California 'migrations,' before a general conclusion is drawn, is a careful accumulation of facts. In the early spring of 1926, there was a migration of the 'painted lady' through Palo Alto, California, in the Santa Clara Valley. The movement lasted several days and cannot by any possibility be explained by wind drift. Neither the origin nor outcome of this migration is known; it is not even known whether the swarm started from one area or was cumulative, picking up members as it went; but at the height of the movement the facts were so plain that they could not be misinterpreted. During the two days of March 25 and 26, 1926, I was out of doors nearly all the time and my official duties took me over an

potential of a substance has been established by Richardson, no further information on the nature of the a and b constants has been submitted so far.

I find on examination of the latest experimental data of S. Dushman, I. Langmuir, K. H. Kingdon, L. R. Koller, J. J. Weigle, C. Davisson and L. H. Germer, that, with absolute acceptance of those results for which greatest experimental accuracy may be claimed, and making slight allowance in those cases when, according to the investigators' records of experiments, and, in the case of S. Dushman, in accordance with the investigator's own opinion, such allowances appear to be warranted,

(1) 'a' can be expressed as an exponential function of molecular volume

$$a = Be^{-nv}$$

when B and n are constants.

(2) 'b' can be expressed as a hyperbolic function of molecular volume

$$b = Cv^{-m} - K$$

when C, m and K are constants.

There certainly may be doubt as to the validity of the 'a' equation, as, unfortunately, only six elements are available, and of these, three and two each give a common point on the semi-long curve.

No such doubt is attached to the validity of the 'b' equation, only one element, sodium, out of the fourteen elements, as divergent as tungsten and cæsium, appearing to be seriously out, and even in that case the discrepancy is capable of reduction in the light of Kingdon's equation.

P. FREEDMAN.

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Seasonal Sunshine in Great Britain.

IN reading the correspondence by Messrs Harding and Phillips, in NATURE of May 29, regarding the rival claims of the south-east and south-west of England as to sunshine, it seems desirable to point out that in over-stressing quite trivial differences there is some danger of losing sight of the really important climatic fact of sensible equality between the two districts. The difference, for example, quoted between the average daily amount of sunshine through the year, namely, 4·53-4·49 hours, is just about two minutes a day in favour of the south-western counties. Even if such a difference deduced from a limited number of stations over no more than 35 years is real, which may be doubted, it could scarcely be of any medical or other practical importance.

Mr Phillips objects to the inclusion of South Wales with the south-west counties on the ground that it lowers the sunshine values for the south-west district. The fact, however, that it does so rather tells, in my opinion, in favour of the south-east district, because the sunny conditions of the entire south coast of England stretch much farther north up the east coast than they do up the west coast, leaving the south-east district more centrally situated in the bright belt than the south west. This may be verified from the sunshine maps in "Book of Normals," Sect. III, and may have some significance.

Sunshine is one of several elements that indicate a sharper seasonal variation when the daylight quarters are employed in preference to the thermal quarters which lag a month behind, namely, November-January, rather than December-February, etc. Still better is the seasonal variation exhibited by taking the four-month summer and winter (May-August) and (Nov.-Feb.) respectively, with the two pairs of equinoctial months for spring and autumn—a scheme coming increasingly into vogue. The English climate is such that the average meteorological sunniness or percentage of possible amount varies in the same sense as the astronomical sunniness or length of day. The result is that the actual amount of sunshine exhibits a very close relationship to the solstices in a land where the days are only $7\frac{1}{2}$ hours at the low solstice and as much as $16\frac{1}{2}$ hours at the high solstice. There are some climates, on the contrary, where, with cloudy summers and clear winters, the summer excess of sunshine is but slight.

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Spatial Relations in a Dream.

IN a letter in NATURE of March 17, 1923, Mr. Gheury de Bray described some observations on time relations in a dream. He mentioned that hypnopompic (or hypnostrophic) images "are generally landscapes passing slowly before one's closed eyes, when in an almost awake condition . . . and having one's full reasoning powers while the illusion proceeds." It seemed "that the speed of succession of the images is an inverse function of the degree of wakefulness." A recent experience would tend to confirm these observations. A succession of faintly coloured landscape images was followed by a less ephemeral and apparently more vivid landscape, while there intruded, at first faintly, then more distinctly, sounds which became identified as knocking on the door. In the dream, the image (a well-known landscape) appeared as if the observer were in a vertical position. But after (? during) the disturbing sounds, an awareness of the actual (*i.e.* horizontal) position of the observer resulted in a conformable orientation of the image. As the observer was lying on his right side, the image seemed to have rotated 90° to the right, and thus the same relative position of observer and image, and also the continuity of the dream, were apparently preserved until completion of the wakening process.

J. H. KENNETH.

The Homestead, Clynder,
Dumbartonshire, June 6.

Television or Teleoptics?

IS it too late to enter emphatic protest against admitting into English vocabulary such an excruciating hybrid as 'television'? I am afraid it is, otherwise this term would not have appeared in this journal (July 3, p. 18) as the title of A. R.'s interesting paper, thereby receiving the *cachet* of NATURE. Hitherto the terminology of science has been framed in scrupulous conformity with the unwritten law or rule against the fusion of different languages in a compound vocable. In this case there is all the less occasion for relaxing the rule because there is ready to hand the term τὰ ὀπτικά, employed by Aristotle to denote all that relates to vision—optics. Surely 'teleoptics' would be as convenient a name as the cacophonous 'television,' and would not upset the equanimity of pedants like myself.

HERBERT MAXWELL.

Monreith.

Rotation and Relativity.

THE case of a vortex ring appears to have a special bearing on the question of rotation in relation to the relativity theory. An observer regarding such a ring can establish definitely that the ring is rotating with respect to himself, but not he with respect to the ring, as in the latter case he would see the ring pass round him, himself passing through the ring (together with the rest of the universe) at each revolution. These two cases are not equivalent, and it is suggested that this affords proof that rotation is not relative, but absolute.

A. JAQUES.
J. S. MORGAN.

Liverpool, July 19.

Meteors and the Constitution of the Upper Air.

By Prof. F. A. LINDEMANN, F.R.S.

FROM the earliest times meteors and meteorites have probably been objects of wonder and interest. Astronomers have examined their radiants and established their connexion with certain comets, and physicists have been led by the study of their characteristics to quite unexpected conclusions about the conditions of the atmosphere at great heights. It is these latter developments that it is proposed to describe as briefly as possible.

Practically all meteorites which have been analysed are mixtures of metallic iron-nickel and of an olivine-like glass consisting of a double silicate of magnesium and aluminium, the proportions ranging from pure metal to pure glass. Since there is no real line to be drawn between meteorites and meteors, it seems legitimate to infer that meteors are composed of the same materials. Meteors appear at heights between 150 and 80 kilometres, and disappear at any height above ground-level, the meteorites of course actually reaching the ground. Their brightness varies within wide limits from the faint telescopic meteors invisible to the naked eye to the fire-balls said to rival the sun in brilliance, and their visible life may be anything between a fraction of a second and some fifteen seconds. Their recorded velocities range from some 10 km./sec. to about 100 km./sec., but it is clear from the nature of the case that these figures, especially in the higher ranges, cannot pretend to any great accuracy any more than can the estimates of luminosity. Deceleration along the path has never been certainly observed.

Presumably everybody would agree that meteors are extra-terrestrial particles moving with planetary velocities brought to incandescence by friction against the air. If further information, however, is desired, it is necessary to formulate somewhat more precisely what occurs when the meteor enters the atmosphere. To fix one's ideas it is as well to have in mind a typical meteor, for example, a meteor which appears at a height of 100 kilometres and disappears at a height of 80 kilometres after traversing a path of 60 kilometres in 1·5 seconds. It may be assumed that this meteor appears as bright at a distance of 150 kilometres as a first magnitude star, *i.e.* that it radiates in the 1·5 seconds of its visible life $3{\cdot}3 \times 10^{10}$ ergs.

The first question to be examined is the original size of the meteor. It is easy to show that practically all its initial energy will be converted into radiation; for its speed relative to the air is so great, and collisions between particles moving at this speed and air molecules consequently so violent, that they disturb the electrons: sooner or later these must return to their normal orbits, entailing, of course, the emission of radiation. If all the energy appears as radiation it is simple to calculate the mass of the particle. The total energy is $3{\cdot}3 \times 10^{10}$ ergs, the velocities 40 km./sec., so that its initial mass must have been 0·25 milligrams. If composed of iron, therefore, such a typical meteor would consist of a particle of diameter 1·15 millimetres, *i.e.* about as large as a small shot.

It is now possible to examine what occurs when such a particle approaches the earth's atmosphere. At first the atmospheric molecules are so rare that the effect of one collision with a molecule will have been dissipated before the next occurs. The result of such collisions will be inappreciable. Most of the energy will be used up in ionising and breaking up the molecules, a part will be radiated, a smaller part will perhaps cause local heating and evaporation, but enough light to render the meteor visible cannot be produced. As the meteor approaches the earth, the density of the air increases and the frequency of these impacts becomes greater, until at a certain height the original colliding molecules and the evaporated meteoric molecules have not time to escape laterally from in front of the advancing meteor before they again collide with air molecules. It is in this region that a cap of gas begins to form in front of the particle which protects it from direct impacts and from loss of heat. Heat now begins to flow from this compressed and heated cap of gas into the particle, ultimately causing it to volatilise.

It is only when evaporation is appreciable that a meteor becomes visible. However hot it might be, a particle the size of which is measured in millimetres could not be seen at a distance of a hundred kilometres; when it evaporates its vapour spreads out and is brought to rest by collision with the molecules of the air in a comparatively large cross-section. The radiation emitted in this process from an effective surface measured in square centimetres is what is observed.

It may readily be seen how this qualitative description may be put upon a quantitative basis, and used to obtain information about conditions in the upper air. Meteors cannot appear until the cap of gas begins to form, *i.e.* until the chance of a molecule escaping laterally without further collision with an air molecule is small. We know the speed at which the meteor is travelling; we can make a fairly close estimate of the average lateral component of velocity of the escaping molecules; and, as shown above, we can calculate the size of any particular meteor the distance, brightness, duration and speed of which are known. Therefore we can calculate what the density of the air must have been if a cap was to be formed. This should represent a minimum value for the density at the height of appearance of the meteor. Fig. 1 shows the calculated densities plotted on a logarithmic scale against the height of appearance of sixty-five meteors the speed, brightness, etc., of which had been observed.

A second check may be attained by considering what happens after the cap has formed. A simple application of the kinetic theory of gases enables one to calculate what fraction of the total heat produced by the impact of the moving meteor upon the air will actually flow through the cap into the meteor and become available for heating and finally volatilising it. The total heat is of course equal to the amount of air accelerated in unit time, *i.e.* the product of the atmospheric density with the cross-section and velocity of the meteor, multiplied by one-half the square of its velocity. Hence the flow of energy available for heating or volatilising in terms of the atmospheric density can be determined. Since we are fairly certain of the size and constitution and consequently heat capacity and latent heat of each meteor, we can calculate the

amount of heat necessary to raise it to a temperature at which evaporation takes place (the point at which the meteor should appear), and also the amount of heat necessary to complete the meteor's evaporation (the point at which the meteor should disappear). Therefore the heights of appearance and disappearance can

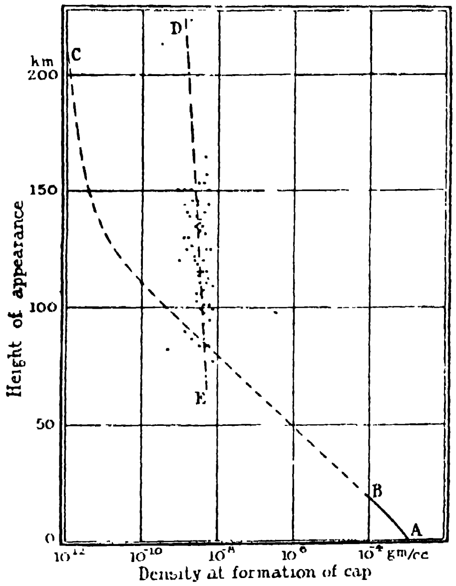


FIG. 1.

be calculated in terms of the observed meteoric characteristics and the atmospheric density, or inversely the atmospheric density can be calculated from the meteoric characteristics. Fig. 2 shows densities calculated on this basis for some hundred meteors plotted as crosses and dots against their heights of appearance and disappearance.

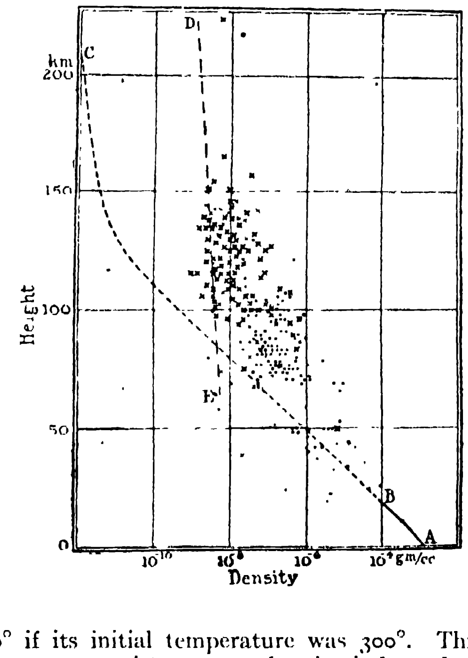
Though one could wish these points lay more closely upon a curve, their agreement may be regarded as satisfactory considering the uncertainty in the observational data, introduced more especially by the determination of the meteor's velocities. The two methods agree quite well among themselves, as is shown by the line DE repeated in Fig. 2 from Fig. 1.

In both figures the line AB represents the density of the air derived from *ballon sondes* observation and the dotted line BC the density calculated, assuming the observed temperature of 220° Abs. at a height of 11 kilometres to remain constant up to the confines of the atmosphere. It is clear that at great heights both methods give very much higher densities than correspond to this assumption. The only reasonable interpretation of the discrepancy seems to be that one is not justified in assuming that the temperature is constant from 25 km. to 150 km. simply because it has been shown to be constant between 11 km. and 25 km. In the accompanying figures the immediate observation of the temperature extends from A to B. In view of the evidence obtained from meteors, it seems quite unjustifiable to extrapolate from B to C. The meteor results would be satisfied if one assumed that the atmospheric temperature increased at heights above about 50 kilometres to something of the same order as the earth's surface temperature or perhaps somewhat higher.

This assumption may be supported by two lines of argument: the first is that further experimental facts seem to accord with it; the second is that it is to be expected *a priori* on the ground of known physical laws.

We may first consider four empirical facts which seem to agree with the view that the temperature at great heights is considerably higher than 220° Abs., the first two based on observations of meteors, the last two upon quite independent phenomena.

As has been pointed out, meteorites consist almost without exception of two components, nickel-iron and a glassy olivine-like substance mixed in varying proportions. It has been shown that a meteor can only become visible if it evaporates; therefore the temperature in the cap of compressed gas in front of the meteor must attain a temperature at which iron or olivine evaporate if the meteor is to appear. Now the maximum temperature which gas can attain under adiabatic compression is readily calculated if one knows the initial temperature and the compression ratio. In the case we are considering it may be shown that the compression ratio is $3v^2/2V_0^2$, v being the meteor's velocity and V_0 the molecular velocity. Hence the maximum temperature at the meteor's surface can be determined in terms of the velocity of the meteor and of the initial temperature of the air. Iron and olivine will only evaporate sufficiently rapidly to give rise to a visible meteor if the temperature is above 2000°. Meteors have been observed moving at a velocity of 12 km. per sec. Our formula tells us that air compressed by a particle moving at 12 km. per sec. can only reach



2000° if its initial temperature was 300°. This provides a very satisfactory and quite independent confirmation of the previous result.

A second somewhat more doubtful check may be found if the number of meteors which disappear at various heights is examined. It is found that whilst many meteors disappear between 100 km. and 60 km.

and many below 50 km., scarcely any disappear between 50 km. and 60 km. So far only one reason has been put forward to account for this quite unexpected fact. As we have seen, the hotter the air is, the greater the flow of heat into the meteor. For a meteor approaching the earth there should be, on our theory, a region in which the air's initial temperature falls from 300° to 220°, giving rise to a corresponding fall in the flow of heat. In this region one would expect a slower rate of evaporation and therefore diminished luminosity; this effect would, however, soon be outweighed by the increased friction and heat production due to increased air density. It is clear that such a region is the most unlikely one for a meteor to disappear; if it reaches it at all it will probably penetrate into the cooler but denser atmosphere below. The only explanation for the fact that no meteors have been observed to disappear at 55 km. seems to be that somewhere between say 52 km. and 57 km. the temperature of the air rises from the 220° of the stratosphere to the higher temperatures in the neighbourhood of 300° of the outer regions.

This view is confirmed in two very striking ways. As is well known, sources of sound are surrounded by alternate zones of audibility and silence. The distribution of these zones has been explained by the assumption that the velocity of sound increases at great heights. Recent investigations have shown that the height at which this increase should occur in order to account for the observed facts is of the order of 50 km. Clearly the well-known increase in velocity of sound with temperature would explain this otherwise inexplicable acoustical phenomenon if the view put forward above is correct, namely, that the temperature increases rapidly with height in this region.

A fourth argument in favour of this, though as yet not really a convincing one, is found in the well-known anomalies in the propagation of wireless waves. Notoriously the observed facts seem explicable only on the assumption that there is a conducting layer, the Heaviside layer, at a height varying from 50 km. at sunset to some 80 km. at sunrise. One can, with some plausibility, attribute this conducting layer to solar ionisation by day, but it seems difficult to account for its persistence at night otherwise than by assuming that the solar radiation forms some unstable compound which gradually reacts or breaks up forming ions during the hours of darkness. Such a substance is ozone, and it is clear, owing to the enormous increase in the rate of reaction with temperature, that the layer of maximum ionisation after sunset will be the lowest layer at which a high temperature exists, and that this will move up as the ozone is used up during the night to regions of lower density in which the rate of reaction is smaller. This hypothesis, of course, awaits many further checks, *e.g.* by observations at high latitudes during the polar night; but whatever the outcome, the observed fact that the height of the Heaviside layer after sunset lies between 50 km. and 60 km. seems very significant.

Finally, it might be worth while to discuss briefly the theoretical aspect of the high temperatures which observation seems to imply. Roughly speaking, above the troposphere, the region of convective equilibrium, the temperature is determined by radiation alone. Clearly a black or grey body would reach the mean temperature of the earth's surface, for this is the temperature at which emission balances absorption. The gases of the atmosphere are scarcely to be compared to black or grey bodies, however. The main constituents are, from the radiative point of view, somewhat dull and inert. Apart from the rather weak bands of oxygen in the red, neither oxygen, nitrogen nor argon has any well-marked absorption, and therefore emission bands at wave-lengths greater than 2000 Å.U., *i.e.* those to which practically all the sun's emission is confined. Infra-red absorption seems to be the function of the water-vapour, carbonic acid and the ozone. Now if one has a gas with strong absorption bands, even if mixed only in a small proportion with a neutral gas such as nitrogen, it will impose upon the whole mixture its own radiative equilibrium temperature. For the active gas will absorb radiation, and either pass it on to the neutral gas by a 'collision of the second sort' (Stoss zweiter Art) or re-emit it. Equilibrium between energy loss by impacts and gain from collisions will be established when the temperatures are equal. Hence we need only consider the 'active' gases water-vapour, carbon dioxide, ozone and oxygen.

Immediately above the troposphere, say from 10 km. to 50 km., the effect of the oxygen will be unimportant. Its absorption in the visible region is small; the rays it can absorb in the far ultra-violet will have been filtered out by the oxygen above. The influence of ozone might be more important, but it will be far outweighed by the effect of the water-vapour and the carbonic acid, the concentration of which in this region is considerable. The concentration of water-vapour at 11 km. will probably be about $2{\cdot}5 \times 10^{-8}$ gm./cm.^{3}, falling to about 4×10^{-10} gm./cm.^{3} at 55 km. The concentration of carbonic acid will be about $1{\cdot}2 \times 10^{-7}$ gm./cm.^{3} at 11 km., falling to about $7{\cdot}5 \times 10^{-12}$ gm./cm. at 55 km. The total amount of ozone above 11 km. amounts to about $1{\cdot}4 \times 10^{-5}$ of the whole amount of oxygen above this level, but its exact distribution is at present unknown. Presumably it is formed by the sun's ultra-violet radiation, which is absorbed by oxygen at wave-lengths below 2000 Å.U. In this case the amount formed per cm.^{3} must reach a maximum somewhere in the neighbourhood of 60 km. At greater heights the decrease in the partial pressure of oxygen outweighs the increase in intensity of the solar radiation. At lesser heights so much of the initial radiation of the effective wave-length has been absorbed that its loss is not counter-balanced by the increased concentration of oxygen. Hence it is above 50 km. that the concentration of ozone compared to the concentration of water-vapour and carbonic acid becomes important.

Now the equilibrium temperature of the air will be some sort of mean between the equilibrium temperatures in these three gases. The equilibrium temperature of carbon dioxide is easy to calculate. It has only one strong absorption band at $14{\cdot}6\mu$, and its temperature will be found by equating the emission from this band to the absorption. Since there is very little energy in this part of the solar spectrum, the carbon dioxide only absorbs energy from the layers below, more especially the earth, whilst it radiates both upwards and downwards. Its equilibrium temperature is therefore low, about 236°. The value for water-vapour is not so easy to determine, on account of its complicated absorption spectrum. It also absorbs in the infra-red only, and

therefore has a low equilibrium temperature, probably between 200° and 220°. The case of ozone is even more complicated, since it absorbs not only at $9{\cdot}5\mu$ but also to a certain extent in the visible and very strongly in the ultra-violet below 3000 Å.U. Since a not inconsiderable fraction of the sun's radiation (probably more than 1 per cent.) lies in this region, this amount of heat as well as that abstracted from the visible part of the spectrum has to be accounted for in some form or other. It can only be re-emitted by pure ozone at a wave-length of $9{\cdot}5\mu$, and its equilibrium temperature when exposed to sunlight and the earth's radiation would therefore be correspondingly high, probably well above 300°.

The general picture may therefore be drawn in outline as follows. At low heights in the troposphere we have convection and therefore an adiabatic temperature gradient. Above 11 km., at which height the temperature has fallen to the equilibrium radiative temperature, *i.e.* 220°, convection will be damped out. From here on one should have a compromise between the radiative equilibrium temperatures of the various active gases. At 11 km. the effect of water and carbon dioxide will preponderate and a low temperature will obtain, but as one ascends, the carbon dioxide disappears and the water diminishes, whilst the ozone with its high equilibrium temperature will become more and more dominant. Above 60 km. the effect of ozone should outweigh that of the other gases and the air should approach the equilibrium temperature of this gas, *i.e.* about 300°, as is indicated by the various more empirical arguments we have outlined.

Whether the agreement of all these forms of indirect reasoning is regarded as convincing is of course a matter of personal opinion. Final certainty can only be attained by direct measurement. It is much to be desired that such immediate observations be made at the earliest possible moment, but the expense and difficulty at present seem to be prohibitive.

Methods and Results of the American Museum Expeditions in the Gobi Desert, 1922-25.[1]

By Prof. HENRY FAIRFIELD OSBORN, For. Mem. R.S.

A NEW volume in the life-history of the earth, composed up to the present of twenty-four chapters (see table below), has been revealed by the discoveries of the Mongolian Expeditions of the American Museum of Natural History, under the leadership of Roy Chapman Andrews. Central Asia, and especially the region east and south-east of Chinese Turkestan, long remained the *terra incognita* of geology, palæontology, and, in a minor sense, of geography. In 1900 the lecturer predicted that the unknown high-plateau region of Central Asia, rather than the well-known Asiatic provinces on the south, such as the Siwalik Hills of India, explored by Hugh Falconer (1830–50), would prove to be the chief centre of the origin and distribution of the mammalia from which waves of north mammalian life radiated to the continents of Europe and of North America.

Andrews's expeditions in the three seasons of 1922, 1923, and 1925, have not only completely verified this prediction, but have also revealed the high Central Asiatic plateau region as the chief home of the terrestrial deinosaurian reptiles of Upper Jurassic and of Cretaceous time. In brief, these discoveries establish Mongolia as a chief centre of northern terrestrial life-history, from the close of Jurassic time onwards to the very close of Pleistocene time.

From the point of view of palæogeography, the outstanding geological discoveries of the expedition are:

First, this Central Asiatic continent of Gobia, as it has been named by Grabau, was for several millions of years extremely favourable to the evolution of reptiles, mammals, insects, and plants, and probably birds as well, hitherto known along the low-lying Cretaceous forelands of western Europe (such as the Wealden of England and Belgium), and in less degree of southern Asia. Secondly, this now terribly desert region of Gobia, traversed only by the gazelle and the wild ass, and thoroughly uninhabitable in the summer season, was abounding in life throughout Upper Jurassic, and throughout all Cretaceous and Tertiary time, sparsely forested, traversed by streams and rivers, with a limited seasonal rain-supply like the high-plateau region of Central Africa to-day. Thirdly, these dry and stimulating upland conditions of Tertiary time, as compared with the densely forested conditions of the Asiatic lowlands, have led to the recent prediction by the lecturer on returning from Iren Dabasu in 1923, that this region is the most likely one in which to search for the Tertiary ancestors of man, namely, those of Eolithic or Dawn-stone Age, though no traces of man have, as yet, been discovered by the expedition older than those of Lower Palæolithic age. The discovery of human and pre human remains in Tertiary time has thus become one of the chief remaining objects of the expedition.

During the season of 1925 a great culture-camp, probably of Azilian-Campignian time, was discovered on the eastern slopes of the Altai Range, not far from Shabarakh, and not far from Djadokhta, where the now famous deinosaur eggs were discovered, far north of the Ordos locality explored by Licent and Teilhard de Chardin. In fact, these Upper Palæolithic artisans collected the broken shells of the deinosaur eggs with which to manufacture necklace ornaments, these perforated fossil shells serving as well as the recent eggshells of the giant Struthiolithus, the great ostrich of the Stone Age of Mongolia.

No human fossils have so far been found: the industrial levels are not as yet precisely determinable, but the chief anthropological fact is established that the Stone Age tribes spread over the borders of the Gobi Desert region during the Ice Age, establishing their quarries near the large lakes bordering the Altai Mountains on the east and fed by glacial streams. The geologists of the party have discovered traces of this glacial age along the summits of the Altai Range.

As for methods, by combining a very large caravan for the camel transport, which leaves Kalgan on December 1, and reaches the eastern base of the Altai Range on May 1, with an automobile train of five to

[1] Abstract of a lecture delivered by the author to the Geological Society of London on June 23.

seven cars, the expedition had the great advantage of speed over the previous geological explorers who crossed the Desert with camels only. The geologists and palæontologists of the party, Granger, Berkey, and Morris, with two field assistants, also had the advantage of prolonged experience in the field formations of the western United States, which, between the 50th and 40th parallels of latitude, present conditions remarkably similar to those found in the Desert of Gobi. Raphael Pumpelly in 1864, Ferdinand von Richthofen in 1872, and V. A. Obruchev in 1909, found no fossils, except the single rhinoceros-tooth brought back by Obruchev; and other geologists traversing this region have thought that there were no fossils to be found.

As to geology, the expeditions beginning on April 15, 1922, 260 miles north-west of Kalgan, and encircling in 1922, 1923, and 1925, the entire Gobi district in a 3000-mile radius, discovered no fewer than twenty-three distinct geological formations extending downwards from Lower Pleistocene time into Lower Cretaceous and Upper Jurassic. These have a thickness varying from 50 to 3000 feet, and were deposited either in the great flood-plains of ancient rivers, or in broad river-valleys, or at the base of ancient mountain-chains, or in the torrents of great sand-storms such as the Djadokhta, testifying to the secular vicissitudes of climate, mostly of rainfall, terminating with the pluvial period of the Ice Age, followed by a long period of secular desiccation.

Some of these formations prove to be closely contemporaneous with the Lower Cretaceous Wealden of western Europe, owing to the presence of large iguanodonts, equalling the famous *I. bernissartiensis* of Belgium in size. The oldest are as early as the Oxfordian and Purbeck of Upper Jurassic times. The climax of reptilian life is reached in the marvellous sand-swept deinosaur breeding-grounds (Djadokta formation) of Middle Cretaceous time, where nests of fossil eggs and innumerable skulls and skeletons of Protoceratops are found in almost perfect preservation. This is the richest deinosaur deposit thus far discovered in Eurasia.

As to the fifteen succeeding Tertiary formations, they compose so many unbroken chapters of the history of Mongolian life as extend from the basal Eocene Gashato to Upper Oligocene time, where the giant Baluchitherium occurs, as discovered also in Baluchistan by Cooper of Cambridge, and in Chinese Turkestan by Borissiak of Moscow. The Miocene and the Pliocene periods are represented by four formations.

Thus the scientific staff of the Expedition, between the years 1922 and 1925, has interpreted one of the most typically desert regions of the entire world by means of the twin sciences of palæontology and geology, and the wilderness of Mongolia now blossoms forth with its glorious story of prehistoric life, as the homeland of the greater number of known upland terrestrial vertebrates.

STONE AGE, TERTIARY, AND CRETACEOUS FORMATIONS OF MONGOLIA, IN DESCENDING ORDER

Regions	*Formations and Thickness estimated in feet*		*Probable or estimated Geological Age*	*Human Culture, Mammalian and Reptilian Life-zones.*
Altai Piedmont	Shabarakh Usu	50 +	Upper Palæolithic	? Azilian Campignian
,, ,,	Orok Nor	5–40	Middle Palæolithic	? Aurignacian Mousterian
			Lower Palæolithic	? Acheulean or ? Eolithic.
Orok Nor basin	Khunuk	27–120	Lower Pleistocene	? Equus, ? Mastodon
Tsagan Nor basin	{ Tsagan Nuru / Gochu }	{ 50 + / 1000 + }	Lower Pleistocene	? Equus, ? Struthiolithus.
Eastern Altai Mt	Hung Kureh	1000	Upper Pliocene to Lower Pleistocene	Hipparion Camelus zone
Iren Dabasu basin	Pang Kiang	500	Miocene, age doubtful	Rodents ? Ochotona.
Eastern Altai Mts	Loh	100–1000	Middle Miocene	Mastodon (Serridentinus) zone.
,, ,, ,,	Hsanda Gol	3000	Middle to Upper Oligocene	*Baluchitherium grangeri* zone
Iren Dabasu basin	Houldjin	30–50	,, ,, ,,	,, ,, ,,
Orok Nor basin	Elegen	0–200	,, ,, ,,	? Mammals undetermined
Chassutai Trail	Baron Sog	5–30	Middle Oligocene	? Large Titanotheres
,, ,,	Ulan Gochu	?–60	Lower Oligocene	? ,, ,,
Chassutai Trail	Ardyn Obo	500	,,	*Brontops gobiensis* zone
,, ,,	Shara Murun	200	Summit of Eocene	*Protitanotherium mongoliense* zone. *Amynodon mongoliensis*.
Shara Murun basin	Tukhum	50 +	Upper Eocene	Titanotheres abundant.
Iren Dabasu basin	Irdin Manha	? 100	,, ,,	Eudinoceras, Andrewsarchus zone.
,, ,, ,,	Arshanto	40–100	? Middle Eocene	Lophiodonts Schlosseria zone
Kholobolchi Nor basin	Kholobolchi	1000	? Lower Eocene	Coryphodon zone
Eastern Altai Mts	Gashato	300	Basal Eocene (Palæocene)	Prodinoceras zone Palæostylops.
Eastern Altai Mts	Djadokhta	500	Middle Cretaceous	Protoceratops andrewsi zone
N.-E. of Shabarakh Usu	Dohoin Usu	200 +		Deinosauria, Crocodilia Chelonia zone
Iren Dabasu basin	Iren Dabasu	180	Lower Cretaceous ? Wealden	Iguanodont Ornithomimidæ
Oshih basin	Ashile	2000	Upper Jurassic	Psittacosaurus zone Asiatosaurus. Prodeinodon
Tsagan Nor basin	Ondai Sair	500	,, ,,	Protiguanodon zone.

The British Association at Oxford.

BY the time that the present issue of NATURE is in the readers' hands, the meeting of the British Association for the Advancement of Science will be in full progress. The Sheldonian Theatre, where Mr. Disraeli made the celebrated announcement that he was "on the side of the angels," will have been the scene of yet another important gathering; and the chief social events of the meeting, namely, the receptions by the Vice-Chancellor, the Mayor, and the Dean, Canons, and students of Christ Church, will have taken place at the Examination Schools, the Town Hall, and Wolsey's great foundation respectively.

Among the institutions of Oxford which combine historical with scientific interest, not least must be reckoned the Botanic Garden on the south side of the High Street, opposite Magdalen College. This, the earliest botanic garden now existing in England, was founded by Henry, Lord Danvers, in 1621, and was intended by him to be put in the charge of John Tradescant, gardener to King Charles I., who, however, died before the appointment took effect. The scientific movement in Oxford, which began in the days of the Commonwealth under the auspices of John Wilkins and his associates, and culminated in the establishment of the Royal Society soon after the Restoration, was carried on by Elias Ashmole. It was to Ashmole that the younger Tradescant bequeathed the natural history and antiquarian collection begun by his father, and to Ashmole himself the University was indebted for the gift of the Tradescant collections, to which that industrious collector had made large and important additions.

It was not until 1669 that Lord Danby's 'physick garden,' which had failed to secure the services of either Tradescant, was equipped with a regular professor. This was Dr. Robert Morison, who delivered courses of lectures, one of which was attended in 1675 by John Evelyn. A great benefactor to the establishment was Dr. William Sherard, who left a permanent endowment for the professorship of botany. It was Sherard who invited the famous Dillenius to take up his residence in England, and provided, by the terms of his will, that Dillenius should be the first occupant of the Sherardian chair. Linnæus, who visited Oxford in 1736, was entertained by the professor, and endeavoured, though without success, to convert him to his new system of classification. In spite of their inability to see eye to eye in botanical matters, the two men formed the highest opinion of each other's merits. The Oxford professor, for his part, "detained Linnæus for a month without giving him an hour to himself the whole day long; and at last took leave of him with tears in his eyes, after having given him the choice of living with him till his death, as the salary of the professorship was sufficient for them both." The Swedish botanist declined this generous offer, but after his return home wrote, "In Anglia nullus est qui genera curet vel intelligat praeterquam Dillenius," and moreover, "founded the genus Dillenia, of all plants the most distinguished for the beauty of its flower and fruit, like Dillenius among botanists" (Gunther, quoting Claridge Druce).

The next professor, Dr. Humphrey Sibthorpe, is said to have given only one lecture, and that a bad one; but his son and successor John was a man of different stamp. Besides projecting and partly carrying out a great work on the flora of Greece, he founded and endowed the professorship of rural economy which still exists.

A new epoch of efficiency and activity dawned with the appointment of Dr. Daubeny in 1834. The energy and persistence of the new professor speedily resulted in considerable additions to the buildings and in extensive improvements in the usefulness and attractiveness of the garden. The reforms set on foot by Daubeny have been continued and developed by his successors, notably by Bayley Balfour, Sidney Vines, and the present occupant of the chair of botany, Sir Frederick Keeble.

Part of the extensive scheme devised by Acland for bringing together in one place all the various departments of natural science, with the view of "the development of a complete national education in science," involved the removal of the lecture-rooms, laboratories, and other appliances for botanical study to the neighbourhood of the new museum, while a 'garden of instruction,' some five acres in extent, would have been established in the Parks. A clever skit by Mr. Edward Chapman, of Magdalen College, cast ridicule on the scheme and did much to cause its abandonment. Many, however, will still think that the plan had great advantages; and it is to be observed that it has since been found quite impossible to carry out within the precincts of the ancient garden all the botanical teaching which has now become necessary.

A very attractive feature of the present meeting will be the opportunity of visiting, by the kindness respectively of Mrs. G. H. Morrell, Sir Arthur Evans, and Mr. Henry Balfour, their exceptionally fine gardens and grounds in the immediate neighbourhood of Oxford. The grounds of Headington Hill Hall, the residence of Mrs. Morrell, are far-famed for their beauty, their extent, and their picturesque situation on the side of the hill overlooking the city. From them can be seen the best views of the University and College buildings to be had anywhere. Youlbury (Sir Arthur Evans) and Langley Lodge (Mr. H. Balfour) have also their own points of exceptional beauty and interest. As an example of a city garden, that of Exeter College, with its boundary formed by the Divinity School and the library of Humphrey Duke of Gloucester, cannot easily be surpassed. The party to be given in these pleasant surroundings by the Rector and Fellows of the College is certain to be highly appreciated by their guests.

The conversaziones to be held at the Ashmolean and University Museums on the evening of August 10 will end the public entertainments of the present meeting. Both are likely to be especially attractive to the devotees of the arts and sciences respectively. The short lectures, demonstrations, and exhibits at the University Museum have been chiefly organised by members of the Junior Scientific Society of the University, an association the zeal and activity of which are among the most hopeful signs of present-day life in Oxford. F. A. D.

Dr. D. H. Scott writes: "In addition to the list given in NATURE of July 31 of distinguished guests from abroad attending the Oxford meeting of the British Association, may I mention that we are also expecting Dr. R. Kräusel, of Frankfurt? In conjunction with Dr. H. Weyland, Dr. Kräusel has made important discoveries in the Middle Devonian flora, showing that the plants of that early period were considerably more advanced than had been realised before. He is giving an account of his results in the Section of Botany."

Obituary.

REV. T. R. R. STEBBING, F.R.S.

THERE must be very many students of the Crustacea scattered all over the world who will read with a sense of personal loss that the Rev. T. R. R. Stebbing is dead. Some of us who are now grey-haired look back to the time when we first discovered the unfailing kindness and patience which allowed the most ignorant beginner to dip into his endless stores of knowledge, and find it hard to realise that we can no longer 'ask Stebbing' when we come to some particularly knotty point in nomenclature or bibliography.

Thomas Roscoe Rede Stebbing was the son of the Rev. Henry Stebbing, D.D. He was born in London on February 6, 1835, and was the seventh in a family of thirteen, several of whom inherited the literary tastes and abilities of their father. From King's College School he went to Lincoln College and later to Worcester College, Oxford. His academic career was distinguished, but his studies were exclusively classical and literary. He obtained a second in *Lit. Hum.* in 1856 and a first in law and modern history in 1857. In 1858 he took orders, being ordained, it is interesting now to recall, by the Bishop of Oxford, Samuel Wilberforce. Masterships at Radley and Wellington were followed by a fellowship and tutorship at Worcester College, of which he was in turn vice-provost and dean.

Stebbing resigned his fellowship in 1867 on his marriage with Mary Anne, daughter of W. W. Saunders, F.R.S., the well-known entomologist, and took pupils, first at Reigate and afterwards at Torquay. At Torquay he became acquainted with some enthusiastic local naturalists, among whom was William Pengelly, under whose inspiration he began to take an interest in natural history. He has told how it was that, already in middle age, he was led to the serious study of zoology. "Having become much interested in Natural Science, and having also been trained in the strictest school of evangelical theology, I had conceived it to be a duty to confute the vagaries of Darwin. But, on reading the 'Origin of Species,' as a preliminary, it has to be confessed that, instead of confuting, I became his ardent disciple." He threw himself into the controversy then raging, and a volume of "Essays on Darwinism" published in 1871, as well as a letter to NATURE in April of the same year, replying to a scornful *Times* review of the "Descent of Man," drew upon him, as we may gather, a good deal of ecclesiastical hostility. From then onwards he continued his advocacy of a liberal theology in essays and magazine articles, some of which are reprinted in his "Faith in Fetters" (1919) and "Plain Speaking" published only a few months ago. Some of these essays now read like echoes of "old, unhappy, far-off things,"—so far off, at any rate, as Dayton, Tennessee!

It was a desire to become acquainted at first hand with some of the facts of Nature on which the evolution theory rested that led Stebbing to take up the study of Crustacea. After some early papers on British species he was entrusted, on the recommendation of his friend Canon A. M. Norman, with the description of the Amphipoda obtained by the *Challenger* expedition. He gave up teaching in order to devote himself to this task, and after some six years' work he produced his report (1888), which fills three of the large quarto volumes of the *Challenger* series. It is not too much to say that this report set a new standard for systematic carcinology, especially in its admirable bibliographical introduction, giving a critical analysis of everything that had been written on the Amphipoda down to the year of its publication. This report and the scarcely less important volume on the Gammaridea contributed to "Das Tierreich" (1906) are Stebbing's best-known works, but a long series of memoirs and lesser papers, extending over more than half a century, contained contributions of fundamental importance on every order of the Crustacea.

Occasional more popular articles and addresses, as well as his "History of Crustacea" (International Science Series, 1893) and the "Naturalist of Cumbrae" (1891), a biography of Dr. David Robertson, give scope for the play of a whimsical and almost boyish sense of fun.

'Scholarly' is the adjective that comes first to the pen in writing of Stebbing's work. Trained exclusively in the disciplines of the older learning and turning to the study of science only in mature life, he brought to it that feeling for antiquity, that sense of the historical perspective of knowledge, which is often wanting in those whose education has been definitely scientific. His erudition seemed boundless, but he wore it with so unaffected a modesty that rash controversialists, less well equipped, were sometimes lured on to their confusion.

Stebbing was elected a fellow of the Royal Society in 1896. He served as a vice-president of the Linnean Society, and later (1903–1907) as zoological secretary. He took a prominent part in the movement for the admission of women to the fellowship of the latter society, and his wife, an accomplished botanist, was one of the first group of ladies admitted. Of the many honours that came to him, none was more valued than the Linnean medal awarded to him in 1908.

Mr. Stebbing died at Tunbridge Wells, where he had resided for many years, on July 9.

W. T. CALMAN.

WE regret to announce the following deaths:

Dr. R. H. Clarke, formerly demonstrator of physiology at St. George's Hospital, London, author of an atlas of sections of the brain of the cat and monkey published in the *Journal fur Psychologie und Neurologie* and joint author with Victor Horsley of a number of papers in *Brain*, on June 22, aged seventy-five years.

M. Albert Frouin, for many years in the physiological research laboratory of the Pasteur Institute, Paris, who has worked on the physiology of digestion, the biochemistry of bacteria, the tubercle bacillus, and particularly the antitubercular action of the salts of the rare earths.

M. Albert Viger, for thirty years president of the French National Horticultural Society, and seven times Minister of Agriculture, on July 8.

News and Views.

DR. A. W. BORTHWICK, formerly lecturer in forest botany at the University of Edinburgh and afterwards serving under the Forestry Commission, was recently appointed to the new chair in forestry at the University of Aberdeen. In his inaugural address, after a preliminary survey of the increasing utility of the products of the forest in supplying many of the everyday needs of the public, and the consequent necessity for the conservation and efficient management of forests, he dealt with the rôle of the university in connexion with the practice of forestry. He considers that a university school of forestry should have three principal aims: (1) To give instruction in the theory and practice of forestry; (2) to conduct research; (3) to advise and assist the owners of forest lands in the management of their woods. "Each of these aims," said Prof. Borthwick, "is important in itself, and not the least important is No. 3. The Department can be of direct help to owners of forests and forest lands, by correspondence, lectures, and personal inspection of woodlands, plantations and lands to be planted. In return the Department is kept in close touch with field problems as they arise, and this is bound to be of use in indicating the kind of instruction to be given to young foresters in training, and also in bringing to notice problems for the elucidation of which further research is required. By concentration on (3) such aims and correlating them into an organised unity, the Department will be kept from going to sleep, a condition only too liable to occur when an overdose of academic forestry is indulged in."

IN the above remarks Prof. Borthwick would appear to be referring to British woods alone. Whilst these are of very great utility for the more elementary portions of the practical courses given to the university forestry student (the future commissioned officer), the latter would be very inadequately equipped for his work, either in Great Britain or out in the Empire forests to which service the greater proportion of the university-trained men go, were the instructor to confine the practical work or his own studies to Great Britain. Prof. Borthwick correctly recognises the importance of this part of the work, and gives an interesting dissertation on the varied branches of forestry education. But his address does not lay stress on the necessity of giving to the future university graduate in forestry practical courses on a far higher plane than anything which Great Britain can provide. To turn out graduates for service either at home or in the Empire (where the demand is far larger) necessitates a continuous study on the part of the staff of the changing conditions and progress (alluded to by the author himself) constantly taking place in the management of the forests of the world. In practice it has been found that only by such means can the forest officer of the future be sent forth with that wide and unbiassed outlook on forestry problems which it is so desirable that he should start with—in so far as it can be implanted in the minds of young men in the all too short space of a university career.

THE Wellington correspondent of the *Times* announces that Dr. Ernest Marsden, assistant director of education, has been appointed permanent secretary of the new Industrial and Scientific Research Department that is being established in New Zealand. This action has been taken on the recommendation of Sir Frank Heath, Secretary of the Department of Scientific and Industrial Research in London, who has recently completed a tour of investigation in Australia and New Zealand. We referred in our issue of May 15, p. 697, to Sir Frank's recommendations for the reconstitution of the Commonwealth Institute of Science and Industry in Australia, and, again, in the issue of July 10, p. 57, to the Bills which have been passed by the Commonwealth House of Representatives to give effect to these recommendations. In introducing the measures, the Prime Minister, Mr. Bruce, referred to the large sums spent on research in public and semi-public institutions in the United States and stated that, for the present, the new Council for Scientific and Industrial Research in Australia will devote its attention to a limited group of problems—liquid fuels, cold storage, and the preservation of foodstuffs, forest products, animal diseases and pests, plant diseases and pests. It is to be hoped that the Council's activities will soon be extended, while the Science and Industry Fund of 100,000*l*., which has been established for providing assistance to those engaged in scientific research and in the training of students in scientific research, should prove an important step towards meeting the very real need in Australia for competent research workers.

THE personnel of the Commonwealth Council for Scientific and Industrial Research has been announced in the Australian House of Representatives by the Prime Minister. The members are: *Executive Committee*: Mr. G. A. Julius (chairman), Mr. W. J. Newbigin, and Prof. A. C. D. Rivett. *Chairmen of State Committees*: N.S.W., Prof. R. D. Watt (Agriculture); Victoria, Sir David Orme Masson (Chemistry); Queensland, Prof. H. C. Richards (Geology); South Australia, Prof. T. Brailsford Robertson (Biochemistry); Western Australia, Mr. B. Perry (Manufacturing industries); Tasmania, Mr. P. E. Keam (Agricultural and stock-breeding industries). *Co-opted Members*: Prof. E. C. Goddard, Queensland (Zoology and botany), Prof. H. A. Woodruff, Victoria (Veterinary pathology). The Council held its first session on June 22-25, and adopted general plans for work during the next twelve months. Its proposals apply chiefly to primary industries. As was foreseen by Sir Frank Heath, the operations of the Council will be hampered for some time by the lack of a supply of highly trained young investigators. Assistance will be sought from abroad, and extensive plans are being put into effect for sending promising Australian graduates to England and the United States for special training.

THE radio communication Bill, which was to regulate the use of radio in the United States, failed to pass

Congress before the long vacation. During the next six months, therefore, there is a risk of serious confusion in broadcasting development in the States. The Department of Commerce has allotted 89 wave-lengths to 528 stations, and there are 650 further applications for station licences awaiting consideration. Now, however, they are left without authority either to grant or to refuse any application. The Secretary of Commerce, Mr. Hoover, has hitherto been regulating all transmission mainly through a 'gentleman's agreement' with the broadcasters themselves. The Bill discussed in Congress expressly declared that it was the intention of the Federal Government to preserve the channels of radio transmission as "perpetual mediums under the control and for the people of the United States." Licences are limited to two years and are not available to aliens or to any applicant "who has been convicted of monopolising or attempting to monopolise the radio business." Broadcasting is apparently becoming very profitable as an advertising medium in the United States. According to the *Times* of July 27, so much as 50,000*l*. has been offered for the transfer of a licence. Licences were recently issued in Chicago to the Moody Bible Institute and the Chicago Federation of Labour. To farmers in the United States broadcasting has proved to be a great boon. Mr. Pickard, the radio officer of the Department of Agriculture, has stated that broadcasting is doing more for the farmer than any other single contribution of science during the century. Farmers living so far as 60 miles from a railway have been induced by radio lectures to change their methods of farming to more profitable systems.

ALTHOUGH windmills have been in use for more than a thousand years, yet accurate data as to their efficiency cannot easily be obtained. The Institute of Agricultural Engineering of the University of Oxford has therefore made a useful contribution to our knowledge of the subject by publishing a report on the use of windmills, more especially for the generation of electricity. A windmill experimental station was erected on the Annables estate, midway between Harpenden and Luton. The field slopes south-westward towards the Dunstable road, and seven windmill plants of various types have been erected on it. The site is a good one, as it obtains the benefit of unrestricted winds from all directions. Full results of the economic, technical and meteorological observations extending over a period of one year are given. The cost per electric unit utilised varied between 12·7 pence and 4·0 pence. By using improved wheels the cost of production for the smaller and more inefficient mills could be reduced by 30 or 40 per cent. Considering the very small dynamos used, having an output of only a few horse power, these results are quite satisfactory. Some of the plants begin to operate when the wind attains a velocity of about six miles per hour and cease operating when the velocity falls to five miles per hour. The output increases more rapidly than the velocity of the wind. The results prove that, in districts remote from a public electric supply, small windmill power schemes might prove useful and economical. Those who already own an engine-generating set and desire to supersede or supplement it should consider adopting wind power. It is also to be remembered that on higher sites than Harpenden or on districts nearer the coast better results would probably be obtained. In Denmark and Germany considerable use is made of wind power in generating electricity.

ALTHOUGH it may be pleaded that a state of chaos in human undertakings has a certain evolutionary value, as being indicative of potential progress, the complexity of civilised life nevertheless necessitates the logical classification of a vast amount of important information as a condition of ordered progress. Bibliographies of scientific and technical literature come well within this category, and their number is constantly increasing. Collective indexes are indispensable to the scientific worker, and although they are very costly to produce, the labour and expense involved in their production cannot be obviated. Bibliographies of general subjects are less essential and have been comparatively neglected, hence we welcome the publication of "A Bibliography of Research" by the National Research Council of the United States, a small volume containing about 800 references to articles on research that have appeared in scientific, technical and trade journals during the years 1923, 1924 and 1925. To facilitate reference, the material has been subdivided into forty classes, a difficult task which has involved a considerable number of duplicate entries; thus four of five references to the National Physical Laboratory given under the heading 'Physics' are repeated in full, and with different index numbers, under the heading 'Research—General: Laboratories.' The bibliography might also be criticised from the point of view of completeness, to which, however, no claim is made. Thus only one of the annual reports of the Committee of the Privy Council for Scientific and Industrial Research is included; and there are very few references to German (11) and French (18) literatures, whilst other continental countries appear to have been neglected. Although criticisms of this kind are not difficult to make, the publication will undoubtedly be most useful to all interested in the general subject of research, and the National Research Council is to be congratulated upon its production.

IT is gratifying to note that anthropological investigations in Canada continue to be actively prosecuted under official auspices. The report of the Department of Mines for the fiscal year ended March 25, 1925, which has just been issued, contains a report of the Victoria Museum covering the work of the anthropological and the biological divisions. Apart from the work of cataloguing, arranging, and preserving specimens, the anthropological staff has been engaged on a number of field expeditions. Mr. Harlan I. Smith visited the Bella Coola Indians of British Columbia, Mr. C. M. Barbeau was engaged among the Gitksan Indians of British Columbia, Mr. D. Jenness continued his work of the previous fiscal year among the Carrier and Sikani Indians of British Columbia, and Mr. F. W. Waugh visited the

Montagnais Indians of the Lower St. Lawrence, whence unfortunately he did not return, as he disappeared mysteriously after visiting an Indian reservation in September 1924, and has not since been traced. A large number of specimens, photographs, and phonograph records were added to the Museum collections as a result of these expeditions, and records and studies of specific subjects under observation have appeared in various scientific journals.

THE growth of the regional survey movement as the geographer's special field of research and contribution to our knowledge of Great Britain has been marked in recent years. The Geographical Association in helping to foster this movement has published in the *Geographical Teacher*, vol. 13, No. 75, a list of libraries, museums, universities, and societies which have in their keeping or are undertaking surveys for their respective areas, also a long list of actual surveys and a list of civic surveys that have been published. The Association also hopes to make a special collection in its lending library of works and bibliographies dealing with special regions. A bibliography of Hertfordshire is published as a specimen. The lists given in the present number do not claim to be exhaustive, and will be added to from time to time as more information is sent to the Secretary of the Regional Survey Committee, Geographical Association, Marine Terrace, Aberystwyth. Some useful suggestions are also made for uniform systems of registration on maps.

AT a representative meeting held in March last, it was resolved to found an Institution of Fuel Technology, and a committee was appointed to prepare a constitution. A further meeting was held on July 30, when the draft constitution was formally adopted and the following officers were elected: *President*—Sir Alfred Mond, *Vice-Presidents*—Lord Aberconway, Prof. H. B. Dixon, Sir Robert Hadfield, Bart., Lord Weir, and Mr. D. Milne Watson; *Council*—Mr R. A. Burrows, Sir Philip Dawson, Dr. F. A. Freeth, Sir William Larke, Dr R. Lessing, Mr M. Mannaberg, Sir Edward Manville, M.P., Mr. S. McEwen, Lord Montagu of Beaulieu, Sir Richard Redmayne, Admiral Sir Edmund Slade, Mr Wallace Thorneycroft, Dr M. W. Travers, Prof. R. V. Wheeler, Mr. W. A. Woodeson, Mr. G. R. Thursfield, Mr. T. Hardie, Mr. A. H. Middleton, and Mr. W. M. Selvey; *Hon Treasurer*—Sir William B. Peat; *Hon. Secretary*—Mr. Edgar C. Evans, Caxton House (East), Tothill Street, S.W. An autumn or winter meeting for the discussion of papers is to be arranged.

A RATHER severe earthquake, strong enough to throw down a few chimneys and to fissure buildings, was felt in Jersey on July 30 at 2.18 P.M. In France it was felt at St. Malo and Rennes; in England, at Bournemouth and other places on the coast of Sussex and Hampshire. In strength and area of disturbance, it closely resembles two others that have visited the same district during the last half-century. The earlier of these, on January 28, 1878, disturbed an area of about 68,000 square miles, including Havre, Rouen, and Paris, as well as London, Bovey Tracey, Brighton, and St. Leonards. Its centre lies probably a short distance to the east of Jersey. Again, on May 30, 1889, another, and stronger, shock was felt over about the same area, and originated in or close to the same focus.

THE meeting of the British Association at Oxford in 1894 is probably best remembered as the occasion on which Lord Rayleigh and Sir William Ramsay, who have both since passed away, announced the discovery of the new gas argon in the atmosphere. In an article in the August issue of *Discovery*, Sir Oliver Lodge gives some reminiscences of the meeting and makes it clear that it should also take its place in the history of radio-telegraphy. At that time, Hertz had recently died and as a memorial to him Sir Oliver had repeated some of his experiments on the transmission of electromagnetic waves at the Royal Institution, using the Branly iron filings coherer and galvanometer as receiver, instead of the original point coherer and telephone. These experiments were shown again at the British Association meeting, and long and short signals corresponding to the Morse code were transmitted through the air from a neighbouring room to the large lecture theatre of the Oxford Museum, where they were demonstrated to an enthusiastic audience by the aid of a Kelvin mirror galvanometer.

WE have recently received from Prof. S. A. Forbes, Chief of the Natural History Survey Division of the State of Illinois, a reprint of a paper entitled "The Lake as a Microcosm," originally read and published in 1887. This paper, of some fourteen pages, was reprinted many years ago, but has long been out of print. The descriptions of conditions—physical and faunistic—apply especially to the lakes of Illinois, and the paper has therefore been much used by the students in the State University, while reference to problems of general interest has led to a demand for it also elsewhere, and to its reissue in the *Bulletin of the Natural History Survey* (vol 15, article 9).

THE Ministry of Agriculture and Fisheries has recently republished its various leaflets on "Insect Pests of Farm and Garden Crops" in collected form as Section Volume No. 11. Altogether twenty-seven leaflets are reprinted and they form a volume of 111 pages, including introductory remarks on the general principles underlying the application of control measures The production of these leaflets has greatly improved in recent years, and the illustrations are of a higher standard. The information concerning the habits and methods of combating different pests is trustworthy and up-to-date, the results of recent research being incorporated in easily understandable language. There is no doubt that many growers will welcome the appearance of so much practical information in a form more convenient than that of separate leaflets, which are easily lost unless systematically filed. The low price of 1*s*. 3*d*. (post free) should bring the volume within reach of all who are likely to benefit by consulting it. It is obtainable from the Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1.

THE "Statistical Report of the Health of the Navy for the Year 1923" is presented by the Director-General, Surgeon Vice-Admiral Sir Joseph Chambers, K.C.B., and issued by H.M. Stationery Office (5s. net). The returns for the total force (89,100) show a marked improvement in the general health of the British fleet compared with the previous two years, the case, invaliding and death ratios all showing a decrease. This is doubtless largely due to the preventive measures now adopted. Health lectures are given by medical officers, and the men are warned of the risks they run in drinking polluted waters, eating raw vegetables and salads, oysters and other shellfish, and the rôle of flies in the spread of disease is explained. All water taken for drinking and cooking from the shore is chlorinated, and all fresh milk used, unless the source is well known, is sterilised. The excreta of all enteric patients are examined during convalescence on three occasions at monthly intervals, so as to eliminate carriers. All officers and men detailed for the Mediterranean, East Indies, and China stations are inoculated against typhoid and paratyphoid fevers before leaving England.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A public analyst for the borough of Northampton—The Town Clerk, Guildhall, Northampton (August 16). An assistant lecturer in agricultural zoology at the North of Scotland College of Agriculture—The Secretary, 41½ Union Street, Aberdeen (August 19). Lecturers in agriculture, botany, and entomology and zoology at the Imperial College of Tropical Agriculture, Trinidad—The Secretary of the College, 14 Trinity Square, E.C.3 (August 21). An assistant lecturer in electrical engineering at the Royal Technical College, Glasgow—Prof. S. Parker Smith, Royal Technical College, Glasgow (August 23). A research assistant for work in connexion with colliery wire ropes, and a junior research assistant for work on materials and structures used for the support of underground workings—each under the Safety in Mines Research Board—The Under Secretary for Mines, Establishment Branch, Mines Department, Dean Stanley Street, S.W.1 (August 25). A technical officer for design of wireless apparatus for service aircraft and aerodrome use—The Superintendent, Royal Aircraft Establishment, South Farnborough, Hants (August 28, quoting No. A.121). An instructor in bee-keeping in the department of Agriculture of the University of Leeds—The Registrar (August 28). An assistant in the botany department of the University of Aberdeen—The Secretary (August 30). A head of the Department of Industrial Administration and a lecturer in the same subject at the Manchester Municipal College of Technology—The Registrar (September 20).

Our Astronomical Column.

SUNSPOT ACTIVITY.—Of the two naked-eye spots, Nos. 7 and 8, which were on the sun's disc together during the last week of June, the first had entirely disappeared when its position came again into view, and the second had diminished to a relatively small spot. A new group of considerable size has, however, been seen recently in transit across the disc and was a conspicuous naked-eye object to those observers who habitually watch these large spots. In a refracting telescope of 3 or 4 inches aperture, much interesting detail could be seen in the penumbral filaments. In type the group conformed fairly closely to that of a 'normal' stream, with a well-defined circular leader, a composite follower 12° in longitude behind, and a cluster of small unstable spots between. The axis of the stream was inclined about 15° equatorwards Both the leading and following spots were large enough to be visible separately to unaided vision, especially on July 29, when their separation of 12° solar longitude was equivalent to nearly 4′

The latitude of the group should be noted. Hitherto, no important group has appeared this cycle so near the sun's equator. In previous cycles, the first very large spots in latitudes so low as 10° have occurred about two years before the respective maxima. Data of position and area (expressed as a fraction of the sun's hemisphere) of the recent spot are as follows:

No.	Date on Disc.	Central Meridian Passage.	Latitude.	Area.
9	July 24-Aug. 5	July 30·0	11 S.	1/550

NAMING OF MINOR PLANETS.—The three planets that commence the second thousand have received names that recall the circumstances of the discovery of Ceres, the first member of the family, about a century and a quarter ago (*Astr. Nach.* No. 5454). Number 1000, discovered by Reinmuth, has been named Piazzia, after the discoverer of Ceres; 1001, discovered by Beljavsky, has been named Gaussia, after the calculator of Ceres' orbit; and 1002, discovered by Albitzky, has been named Olbersia, after the detector of Ceres at its second opposition. These appropriate names were given by Mr. B. Asplind of Karlstad, Sweden, with the consent of the discoverers.

LUNAR AND PLANETARY TEMPERATURES.—The results of an investigation of planetary temperatures by Menzel, Coblentz and Lampland by means of the radiation transmitted through a water cell, are described in the *Astrophysical Journal*, vol. 63, p. 177. The theory of the method has previously been given by Menzel (*Astroph. Journ.*, vol. 58, p. 65), and rests on the fact that the solar energy reflected from a planet is of short wave-length, whereas the radiated planetary energy is of much longer wave-length. The water-cell transmission gives a measure of the ratio of the short-wave solar energy to the total energy, and hence of the amount of planetary radiation which is able to pass through our atmosphere. This atmospheric transmission depends on the spectral distribution of the radiation, and therefore, finally, upon the planetary temperature. The results of the latest work seem to show that the temperature of Mars may reach 10° C. at perihelion, but with large diurnal fluctuations (the night temperature being probably below −85° C.). The bright areas on Mars appear to be at a lower temperature than the dark areas, and the temperature of the south polar cap ranges from −100° C. to −15° C., suggesting ice or snow as a possible cause. Some results are also given for the moon, Venus, Jupiter, Saturn, and Uranus. There seems to be no evidence of internal heat in any of the giant outer planets.

Research Items.

Royal Costume and Race in Ancient Egypt.—In *Ancient Egypt* for June, Miss M. A. Murray examines details of the dress of kings of the early dynasties of Egypt and suggests that certain inferences bearing upon cultural origins may be drawn from the results. On the slate palette of Narmer, the king is shown wearing a belt at the back of which is an animal's tail with long rippled hair—a bull's tail. Sir Flinders Petrie has pointed out that the bull's tail was a promoter of fertility. While the king was typified by two creatures, the falcon and the bull, he was more truly falcon. The falcon Horus conquered the country, but his religion was exotic, belonging to the king only. Egypt was and remained a cattle-worshipping country, and therefore the king had to become a bull. This was accomplished by a ceremony in which the outward and visible symbol, the bull's tail, was attached to his person. The Sed festival was connected with the tail of the king; but Prof. Newberry has suggested that this was a marriage ceremony. In Crete, when bull-worship was introduced, the queen, through whom, as in Egypt, descent was transmitted, was disguised as a cow for the celebration of the Sacred Marriage with the bull. In Egypt the Sed festival may represent the making of the foreign falcon into a bull at the time of the marriage to the queen of the bull-worshippers. The royal head-dress may suggest the provenance of these rulers. The crowns appear to be turbans. The Red Crown of Lower Egypt is of a form now worn by the Marwaris of Rajputana. This head-dress in Egypt is worn only by the king and by foreigners. It is indigenous in Asia and especially Persia and northern India. The connexion between early Egypt and Elam is established and, in view of the connexion between India and Sumeria, it is possible that there may have been a common centre influencing Egypt.

The Last Forest Phase in Britain.—Mr. O. G. S. Crawford in *Man* for July discusses the implication of certain conclusions of geologists and meteorologists which bear directly upon archæology. From 3000 B.C. until 1800 B.C. the climate of Britain was drier than at present. Further, the land stood 60 feet higher than at present, with forest and fen in the area now the North Sea, and forests on the southern and western coasts. This last forest phase may be equated roughly with the British neolithic period, which has two stages, an earlier with no pottery and no agriculture, and small implements, many resembling palæolithic types, and a later, megalithic, stage, with agriculture and many surviving implement-types which show little change. There is no evidence that the people of the first stage are descended from our palæolithic population, and it is possible that they spread across the fen, which is now the North Sea, from Denmark. On the other hand, the megalith builders were a distinct people. The distribution of megaliths arranged in order of development suggests an eastward migration. This is supported by the legendary connexion of Stonehenge and Ireland and the Irish character of Middle Bronze Age pottery in Pembrokeshire. In eastern Wales and in England south-east of the Severn and south of the Humber, later types of megaliths preponderate over the earlier. This suggests, therefore, that an eastward migration occurred at the close of the dry period when the west was becoming appreciably more moist and difficult for agriculture. Were climatic conditions also responsible for the departure of the megalith builders from their homes in France and Spain?

Winter Climate and the Incidence of Pulmonary Tuberculosis.—The view has been expressed that the poor ventilation of houses consequent upon a rigorous winter climate may be an important factor in the causation of pulmonary tuberculosis. Thus, the higher incidence of phthisis in Sweden compared with England and the high incidence of the disease among the Esquimaux have been attributed to the influence of this factor. J. R. Miner has subjected this hypothesis to examination (*Amer. Review of Tuberculosis*, vol. 13, No. 4, 1926, p. 366), taking as his data the mortality statistics for the white population of the United States Registration Area, which covers a wide range of climate, yet refers to a population fairly homogeneous racially, and highly homogeneous in customs and social environment. The death-rates from tuberculosis of the lungs and acute miliary tuberculosis in the various registration States have been grouped according to January mean temperatures. After the application of various corrections, the result emerges that the white death-rate from pulmonary tuberculosis in the United States is higher in those States with a mean January temperature between 30° F. and 40° F. than in colder or warmer regions. No evidence is found to support the view that severe winter climates, or poor ventilation resulting therefrom, are important factors in the etiology of pulmonary tuberculosis.

Scottish Sea Trout.—Mr. G. H. Nall gives us interesting information on the sea trout of the River Ewe and Loch Maree (Fishery Board for Scotland Salmon Fisheries, 1926, No. 1. (Edinburgh and London: H.M.S.O., 1926.) 4*s*. 6*d*. net), as a result of measurements and scale readings of a very representative number of fish, 1512 in all. Included among these are examples representing the hatches of 12 consecutive years, 1912–1923, fish ranging in size from 3 oz. to 10 lb. and in age from $2\frac{1}{2}$ years to 13 years. Nearly three-quarters of these undertook their smolt migration after three years' river life, thus tending to confirm the theory that length of parr life depends on food supply, northern streams having comparatively low food resources, which leads to long parr life. The record of two fish remaining as parr for six years is interesting, being the first such case recorded for the British Isles. Of the Ewe trout, the scales of which showed spawning marks, 48·8 per cent. spawned for the first time in the second winter after smolt migration and 40·6 per cent. in the third winter. The main runs begin in mid-July and last until autumn. The great majority of fish spawned in successive years. The oldest fish in the collection had spawned eight times and was thirteen years old. In condition, as measured by the standard *K*, these sea trout were good. Sea trout have previously been studied in the River Forth by Menzies and the River and Loch Hope by Nall, who, in this paper, makes interesting comparisons between the fish from the various regions.

Studies in De-differentiation.—Prof. J. S. Huxley has described reduction phenomena in *Clavellina lepadiformis* (*Pubblicazioni della Stazione Zoologica di Napoli*, vol. 7, 1926), in which he confirms Driesch's discovery that whole individuals of this species will undergo de-differentiation or reduction as readily as pieces of the animal. Examination of some of the morphological changes occurring during the process shows that the pharynx and atrium are reduced much more rapidly than any other organs. The nervous system passes through a stage in which the anterior portion is hollow. The heart remains differentiated and active for a long period, but is

finally suddenly reduced to a mass of de-differentiated cells. The gonads may be represented at a late stage by a single hollow vesicle. The digestive loop usually remains very little changed until late stages. The atrium may be converted into two separate vesicles by the breaking and subsequent resorption of its dorsal cloacal portion. The epicard is relatively resistant, and in advanced stages of reduction shows horn-like processes which may be attached to the peribranchial cavities. Some organs may disappear, apparently by cell-migration The view is put forward that the changes cannot be supposed to represent reversions to stages passed through in embryogenesis. The resemblance to such stages is accidental, and is brought about chiefly by mechanical means.

SPERMATOGENESIS IN SPIDERS.—In a paper on the spermatogenesis of the spider, *Tegenaria domestica* (*Bull. Internat. de l'Acad. Polonaise des Sci. et Lettres*, Série B. No. 3-4), Mme. Julia Sokolska shows that the number of chromosomes in the male is 18 pairs, together with an unpaired heterochromosome or X-chromosome composed of three equal bodies, which are separate during meiosis, but all usually pass to the same pole in the reduction division. The two resulting types of sperm can be identified by the visible presence or absence of these three bodies from the spermatids. Abnormal cases were found, however, in which two of the three elements of the X-chromosome separate from the third in the heterotypic division, as well as cases in which four such bodies were present. These clear-cut results contrast in some respects with those of Dr. E. Warren (*Annals of the Natal Museum*, vol. 5, part 3) on the habits, oogenesis, and early development of a South African spider, *Palystes natalius*. After describing the spinning of the egg-sac and the 'psychological behaviour,' a detailed description of the egg development is given. The author falls readily into the old snare of amitosis, and his observations on this head are unconvincing. In the maturation of the egg two polar bodies are formed, but the second is retained within the egg. The author admits that these divisions are mitotic, but in the five cases observed the chromosomes 'averaged' 10 for the first polar body and 9 each for the second polar body and the egg nucleus. Chromosome counts are now, however, of little value unless they are exact. It is to be hoped that an effort will be made to get more precise results

STUDIES ON A PARASITE OF THE HESSIAN FLY.—C. C. Hill contributes (*Journ. Agr. Res.*, Washington, vol. 32, No. 3, 1926) an account of *Platygaster hiemalis*, one of the most widespread and effective parasites of the Hessian fly in the United States. In the eastern wheat-growing regions, this Hymenopterous parasite kills annually from 16 to 40 per cent. of the autumn generation of the fly. The eggs are deposited in the egg of the fly and develop polyembryonically (by twinning) or monembryonically; the resulting yield in adults is about a 50 per cent. increase over the number of eggs deposited. The larva consumes the contents of the host, but the latter, before succumbing, usually succeeds in forming a puparium. Within this the cocoons of the parasite are formed, and an average of six adult parasites emerge from each host. The adult is about 1 mm. long, very active, flies readily, and is positively phototropic. The female is able to reproduce parthenogenetically, and impregnated females usually deposit both fertilised and unfertilised eggs at each oviposition. Approximately 66 per cent. of the adults are females. The female lays from one to eight eggs at a time, and shows marked ability to recognise eggs of the fly in which she has already oviposited. In one instance a female, crawling over a leaf which bore 42 eggs of the fly, oviposited in 24 of these in fairly regular order on the first tour; on the return she brushed all the eggs with her antennæ and attacked two that had not previously been pierced, but only one of those previously visited was pierced a second time. Females have been observed to examine with their antennæ the area on a wheat leaf from which the egg of the Hessian fly had been removed, and even to attempt to oviposit thereon. It would appear that chemotropism plays an important part in the location of the host egg. *Platygaster hiemalis* passes the winter and early spring in the embryonic stage; by the end of August the adults are ready to emerge from their cocoons during the oviposition period of the Hessian fly in the fall of the year.

WEST INDIA HURRICANES.—An important publication upon the hurricanes of the West Indies has been issued by Father Sarasola, Director of the newly organised National Observatory of Colombia ("Los Huracanes de las Antillas." Notas Geofisicas y Meteorologicas Num. II., Bogota, 1925). In addition to marshalling a large number of facts about these destructive visitations, he discusses methods of forecasting and reviews current theories regarding the origin of tropical cyclones. It is pointed out that whereas the cyclones of temperate latitudes are most severe in winter when 'polar front' discontinuities of temperature and humidity are sharpest, tropical cyclones are most active in the warmest season. The view is favoured that tropical cyclones are fundamentally connected with the conflict of air currents, and in this connexion it seems a pity that the author appears to overlook what is really very convincing evidence that this view is correct. Tropical cyclones occur mainly in late summer and autumn towards the margin of the tropics on the western sides of the oceans in both hemispheres, precisely when and where one Trade system having crossed the equator encounters currents from the opposing Trade system, the one exception to the rule being the South Atlantic, which is hurricane-free in the absence of a seasonal migration of the North-east Trade across the equator. This is the significant geographical background of tropical cyclones, and should be observed by all writers who investigate the structure of these storms in detail. Whether there is anything corresponding to the 'discontinuities' of temperate latitude cyclones on 'polar front' principles is not yet clear, but it is likely that there are considerable differences of humidity, if not of temperature, between the opposing currents feeding a tropical hurricane. Father Sarasola's work contains much local detail in relation to the storms of the Caribbean Sea; the wider influences bearing on the subject are not neglected, a good deal of attention being given to solar activity in relation to the weather.

WIND AND SPEED OF WAVES.—In a paper entitled "Observations of Wind, Wave and Swell on the North Atlantic Ocean" in the *Quarterly Journal of the Royal Meteorological Society*, vol. 51, No. 218, Dr. Vaughan Cornish records his observations on the relationship between velocity of wind and waves. He found a close agreement between the wind and the velocity of the waves under the conditions of the final stage reached after a prolonged wind. The discrepancies between the two figures which were apparent in some observations were almost entirely due to swell. A crossing swell effects considerable reduction in the speed of the waves, a concurrent swell little reduction in speed and a diminution in height of the waves. When two sets of swell cross

the waves, their effects in reduction of wave speed are additive. This would explain the rapid rise of waves with wind on large lakes and inland seas when there is little swell to hamper the wave-making action of the winds. Dr. Cornish gives his figures in full and describes the methods he devised to measure the velocity of the wind.

SUBSIDENCE OF KILAUEA VOLCANO.—A rough estimate has been made of the total volume of subsidence of Kilauea during the years 1921–24 (*Volcano Letter*, No. 74, May 25, 1926). At Halemaumau the amount of subsidence in this interval was 13 or 14 feet, and at a distance of twenty miles to the north-east it was little more than an inch. Assuming that the subsidence was symmetrical about Halemaumau as a centre, the total volume of subsidence would be about one-seventh of a cubic mile.

COLOURS DUE TO IRON IN MINERALS AND ROCKS.—In the *American Journal of Science* for July 1926 Mr. G. R. MacCarthy presents the results of a comprehensive study of the colours produced in rocks by various types of iron compounds. It is shown that the natural yellows, browns and reds are due to the presence of ferric compounds. Hydrous ferro-ferric minerals are blue in colour, and are responsible for the blues frequently exhibited by clays and shales. The suggestion that these tints are produced by disseminated organic matter is refuted. Greens are considered to be the result of mixtures of iron-blues and iron-yellows, for no evidence of the existence of any single green compound has been found. The chocolate-red of hæmatite sometimes approaches purple, but the true purple colours of shales and slates are ascribed to mixtures of iron-reds and iron-blues. Anhydrous ferro-ferric compounds produce only greys and blacks, like the carbonaceous matter that is generally present in black argillaceous rocks. The rôle of iron as an inorganic colouring agent has thus been rationally extended over the whole range of colours found in sediments.

CONTRASTED TYPES OF MUD-CRACKS.—Continuing his valuable work on the structural features of sediments, Mr. E. M. Kindle has published and described a most instructive suite of photographs of various types of mud-cracks (*Trans. Roy. Soc. Canada*, 20, sec. 4, 1926, p. 71). A series from the playas of north-western Nevada shows polygonal shrinkage cracks (*a*) with flat tops, (*b*) with curled-up edges, (*c*) with rounded margins, and (*d*) with a reticulation of small polygons within the larger ones. The curling-up tendency is associated with the presence of abundant colloidal matter in the clay, while the downward rounding of other mud-cracks indicates a notable percentage of sodium chloride in the material undergoing desiccation. Another series of desert mud-cracks shows a number of radiating rosette-like fissures, due probably to convection currents in the oozy mud during the initial stages of desiccation. In another type, from Jervis Island in the Pacific and from Southern Australia, the ordinary polygonal cracks are not open fissures, but are outlined by narrow ridges composed largely of alkali sulphates and other salts. It is thus clear that the muds of saline lakes, fresh-water lakes and the sea-shore, develop shrinkage cracks of sharply contrasted types, and the recognition of similar features in older sediments may therefore provide valuable evidence bearing on the origin of the latter, and particularly of continental facies of sediments.

RANGE OF α-RAYS OF THORIUM C + C′.—Experiments with a modified form of the Wilson cloud apparatus, enabling a large number of photographs to be taken one after another under conditions which made it possible to measure the range of the α-rays accurately, are described by Fraülein L. Meitner and Herr Kurt Freitag in the *Zeitschrift für Physik* of June 16. Altogether three thousand photographs were taken. Thorium C breaks up partly into thorium C′ with emission of a β-particle and partly into *C″* with emission of an α-particle, the mean range of the latter being 4·8 cm. Thorium C′ sends out an α-particle with mean range 8·6 cm. and gives thorium lead. The ratio between the numbers of these two classes of α-particles was determined by counting to be 34·3 : 65·7, which agrees well with the value obtained by Marsden and Barratt using the scintillation method. The ranges in different gases were determined and the mean relative braking power of these gases calculated. The variations of the range on either side of the mean were determined in the different gases and compared with the values deduced by Bohr from the classical theory; good agreement was found. The existence of a group of α-rays with 11·5 cm. range in air discovered by Rutherford and Wood was confirmed and a new group with 9·5 cm. range was found. There were on the average 200 of the 11·5 cm. range particles and 70 of the 9·5 cm. range to 10^6 ordinary thorium C′ α-particles The existence of α-particles of greater range than 12 cm., announced by Bates and Rogers has not been confirmed; particles with longer range than this are clearly shown to be hydrogen rays.

DRAWING INSTRUMENTS.—Among other sets of instruments manufactured by Messrs. Harling, 117 Moorgate, London, E.C 2, at their new factory in Upper Clapton is a wallet case, B.E. 114, which we have had the opportunity of testing. This case contains a 4½-inch divider with hair spring adjustment and movable needles; 3-inch bow pen compass and a bow pencil compass of the same size, both instruments having double knee joints, while the ink point of the pen is made of stainless steel. All these instruments are made of hand-drawn electrum; the head joints work on steel cones and are fitted with a device for maintaining the handle upright. The case also includes a set of three spring bows, the steelwork of which is made of stainless steel; these instruments have central screw adjustments, and are both light and rigid in use. There are also a 6-inch drawing-pen, made of stainless steel with a lift-up nib permitting of cleaning and instantaneous resetting to the same width of line, and another 6-inch drawing-pen, also of stainless steel, but without the lift-up arrangement. A pricker is included. All the above described instruments are thoroughly well made; the design is good and the instruments are suitable in a high degree to the work of an engineer's drawing office. The last instrument in the case is a portable beam compass with divider, pen, and pencil points. The duralumin beam of this instrument is made in three lengths with push-in joints, and makes up to 29½ inches. The travelling heads are driven by means of milled rollers. The section of the beam is wedge-shaped, and each head has a spring which presses the head into the wedge and also presses the roller against the top side of the beam. The design is good, the heads move easily, and are rigid whilst circles are being drawn. Unfortunately, sufficient care has not been taken in manufacture to get all three bars of exactly the same cross-sectional dimensions; two of the bars in the set submitted for examination are very good in this respect, and the heads pass easily over the joint of these bars. The other joint is bad owing to the defect mentioned, and the head requires assistance to pass the joint.

Kammerer's Alytes.

(1) By Dr. G. K. NOBLE, American Museum of Natural History, New York, N.Y.

THERE is in existence, resulting from the much-discussed experiments of Kammerer (1919, *Archiv. f. Entwicklungsmechanik*, 45, pp. 323-370, pls. x.-xi.), only a single specimen said to show the modifications described by him. This specimen is preserved in the Biologischen Versuchsanstalt, Vienna, and is the one which Kammerer recently brought with him to England and used to support his contention that he had produced heritable modifications in the midwife toad (Kammerer, 1923, NATURE, 112, pp. 237-238).

Although this specimen had presumably been carefully studied in England—for Kammerer (*loc. cit.* p. 237) claims: "Dozens of scientific men have seen the pads and are now convinced"—a preliminary examination of it by me in Vienna revealed such unexpected features that Dr. H. Przibram and I have found it advisable independently to make a thorough macroscopic, histological and chemical examination of the critical features of the specimen.

It will be remembered that Kammerer claimed to have produced heritable nuptial pads in a batrachian which normally lacks them. I found the specimen to have its left manus blackened both on its dorsal and ventral surfaces, the extent of the darkened area being fairly well shown in a photograph of the specimen made in Cambridge (Kammerer, 1924, "The Inheritance of Acquired Characteristics," New York, Fig. 9). A slight blackening was also to be seen on part of the right manus. Neither manus had the appearance of possessing nuptial pads, but both seemed to have been injected with a black substance, for the blackening included some of the capillaries.

An examination of the blackened areas under moderate magnification with a binocular microscope revealed that the colouring was not epidermal; that is, in epidermal spines, but in the derm. No trace of spines, points, brushes or other asperities could be seen on the integument of the prepollex, or surrounding region of either hand. The left wrist of the specimen had been lacerated. A slight pushing aside of the muscles revealed that the ventral wrist muscles and part of the palmar muscles were surrounded by a black colouring matter on all sides. This substance was in such abundance that it readily washed out in the dissecting dish water which filled the spaces between the exposed muscles. It was clear that these blackened areas were not nuptial pads; that is, patches of pigmented asperities, for the epidermis was not thrown into spines. Further, the colouring matter was not epidermal, but was distributed in great masses under the skin, between the muscles, and even in many of the capillaries on both dorsal and ventral surfaces of the left manus.

Dr. Przibram and I have independently made sections of the integument from the prepollex region of the left manus of the specimen under discussion. This is the region which in the water-breeding Salientia most frequently bears asperities. It is at the base of the first finger. Further, it was the region of maximum blackening in Kammerer's specimen. Although the specimen was poorly fixed, the epidermis in this region was intact, except along one edge where it was beginning to be shed. No suggestion of asperities are visible in my sections. The surface of the epidermis is perfectly smooth. The black colouring matter is seen to lie in great masses in the derm and among the muscle fibres, while some of the capillaries are choked with the same substance. It is therefore clear that no modifications occur in the prepollex region of Kammerer's specimen, other than those produced by poor fixation and the black substance. Dr. Przibram has confirmed from his own sections my observations that no suggestion of asperities are present in this specimen.

The black substance, so irregularly distributed through the muscles, has the appearance of India ink, for under the highest powers the granules are black, not brownish black (or lighter) as most amphibian melanins. However, a critical test as to the nature of this substance is necessarily a chemical one. Oppenheimer (1909, "Handbuch der Biochemie des Menschen und der Tiere," Jena), in describing the properties of melanin, states that it may be changed into a lighter-coloured substance by treating it with concentrated nitric acid. Further, this product is soluble in alkalis. I have carried out a series of experiments with different kinds of amphibian integuments, some injected with India ink, and others merely fixed in alcohol or formol, and have found the test to be critical in distinguishing melanin from India ink. With Dr. Przibram's permission I removed a piece of integument from the palm of Kammerer's specimen at the base of the second finger. A large mass of black substance adhered to the dermal portions of the skin. The piece was cut into three parts and each treated for different periods, first in concentrated nitric acid, and after washing, in concentrated ammonium hydroxide. In spite of this variety of treatment, known to be critical in all cases, the black colouring matter remained intact, while the few small and widely separated melanophores readily observable under the binocular, disappeared. In this resistance to the treatment the colouring matter resembled the India ink masses in our controls. Dr. Przibram has carried these experiments further, and writes: "The black substance has also been subjected to the treatment with antiformin and withstood this reagent, which dissolves all melanins known to now" We may conclude that the substance which gives the dark appearance to the left manus of Kammerer's specimen is not melanin.

It has therefore been established beyond the shadow of a doubt that the only one of Kammerer's modified specimens of Alytes now in existence lacks all trace of nuptial pads. The question remains: Might not this specimen at one time have possessed them? There are available three kinds of evidence bearing on this point: (1) sections said to have been made from the pad of the modified specimens; (2) photographs showing more or less clearly some indication of the pads; and (3) testimony of observers who believe they saw asperities in the modified specimen.

Kammerer (1919, *op. cit.*, Pls. x. and xi.) has produced figures of histological preparations said to be made from the nuptial pad region of his specimens, or to be more exact, (translation) "through the skin of the first (inner) finger." Similar preparations were sent by Dr. Kammerer some time ago to Dr. E. Uhlenhuth, who has kindly loaned them for examination. Further, other microscopical preparations similar to those described by Kammerer are preserved in the Biologischen Versuchsanstalt in Vienna, as a material result of Dr. Kammerer's studies. Both sets of preparations agree fully with the description given by Kammerer. The controls figured by Kammerer, as well as those in Vienna and New York, exhibit a smooth epidermis, while that labelled as coming from the modified individual is thrown into numerous cornified and pigmented spines. It has been claimed that these spines are distinctive in form, and hence the pads must have been produced experimentally in Alytes.

Now, it is a well-known fact that the nuptial spines (and also the pad glands) vary enormously in size within a species. Champy (1924, " Les Caractères Sexuels," Paris, Fig. 104) has well shown how these may vary within the species *Rana temporaria*. My sections of the nuptial pads of *Bombinator igneus* differ enormously from those figured by Lataste of the same species (Kammerer, 1924, *op. cit.*, Fig. 11, sketch 8), for my animal was a terrarium animal in not very good health before it was killed. However, I have attempted in a series of forms to discover breeding pads which agreed in histological detail with the sections sent Dr. Uhlenhuth. My sections of *Bombinator maxima* agree most closely with Kammerer's sections. There is no difference in the height of the spines, their distance from each other, their form, the character of the cores within the spines, etc., between some parts of the pad in this species and parts of the sections sent Dr. Uhlenhuth. But the spines differ in proximity and height in different parts of the pads, which only goes to show that the exact form of these spines is of no value in distinguishing many species of frogs. Kammerer's sections fall within the range of variability shown by the genus Bombinator (more properly called Bombina).

The second group of evidence is to be derived from the photographs. I fail to find anything distinctive in the photograph of the specimen made in Vienna (Kammerer, 1919, *op. cit.*, Pl. x.) or that taken in Cambridge (Kammerer, 1924, *op. cit.*, Fig. 9). Dr. Przibram believes that still a third photograph, one made in Vienna (see the following note) proves conclusively that asperities were present. This photograph is not available to me, but I do not understand how asperities so small as those in Kammerer's sections would show up as Dr. Przibram points out. What proof have we that these " two or three spines " are not foreign bodies; and why do they not show up in the rather good photograph made in Cambridge (Kammerer, 1924, *op. cit.*, Fig. 9) ?

In marshalling the third group of evidence, Dr. Przibram has brought together some distinguished names. With all deference to these gentlemen, I would say that the epidermis of Kammerer's specimen which is underlaid by the black substance appears, in part, slightly irregular. This appearance is probably due to the unequal distribution of the black substance below. At least, it required on my part the most careful manipulation of the lighting to prove that these irregularities were not in the epidermis. Further, I fail to see how any one qualified to pronounce on the presence or absence of nuptial pads could have examined the black discolorations on the forelimbs of Kammerer's specimen without noticing their artificial character.

A final objection which might be raised to the conclusions reached above is that some evidence has been recently presented (Kändler, 1925, *Jen. Zeitschr. f. Naturw.*, **60**, pp. 175-240, Pls. 9-10) to show that the male Alytes may sometimes produce an incipient breeding pad. It is not my purpose to discuss whether the slight crenulations in the surface of the epidermis can be interpreted as an incipient pad. The breeding asperities Kammerer claims to have produced are true nuptial spines similar to those of Bombinator and cannot be compared with the epidermal irregularities of the prepollex or surrounding regions in an occasional male.

The only specimen resulting from the experiments of Kammerer has been the source of much heated argument in NATURE. By describing accurately, for the first time, the modifications in this specimen, we have proved conclusively that no pads are present. Whether or not the specimen ever possessed them is a matter for conjecture.

(2) By Dr. HANS PRZIBRAM, Biologischen Versuchsanstalt, Vienna.

It is clear from the foregoing account that the only one of Kammerer's experimentally modified Alytes still preserved cannot in its present state be regarded as a valid proof of the nuptial pads artificially produced in this species. We must endeavour to decide if the state the specimen is in now agrees with the state at the time of its preservation and before. The specimen is poorly fixed and preserved. Moreover, the epidermis is at several places ready to be shed or even shedding. It is a known fact, as Prof. Franz Werner, of Vienna, asserts, that during repeated handling and shaking the nuptial asperities get lost easily. The specimen has made the voyage to England and back again, and it does not look the better for it. Fortunately, there are photographic plates in existence showing the state of the specimen before it left Vienna for Cambridge and during its stay in England. One of these photographs was taken in the presence of Dr. J. H. Quastel in the atelier of Reiffenstein (Vienna), and the negative travelled with Dr. Quastel to England and has been in the possession of Mr. M. Perkins (Trinity College, Cambridge) since April 1923. A reprint of it is given in Kammerer's " Neuvererbung," Stuttgart-Heilbronn, W. Seifert-Verlag, 1925 (Abb. 9, facing p. 20).

Dr. Quastel asserts in a letter to me, dated Trinity College, Cambridge, March 27, 1926, " with confidence that in the large negative of Alytes (taken by Reiffenstein) there are no traces of any manipulation or retouching of the actual image of the Alytes." Since he is not an expert in photographic matters, he has had the negative examined by an expert photographer, Mr. W. Farren, who gives the following statement : " 76 Regent Street, Cambridge, March 26, 1926.—I have examined carefully the negative of Alytes, and while it appears to have been intensified and a string across the background retouched, there are no signs of any retouching or interference with the image of the specimen itself, or of that part of the background with which it is in contact " Mr. Perkins writes (March 20, 1926) : " The only retouching which the plate has ever shown is a certain obliteration of the thread which supports the specimen, and the fact that retouching has been applied to this, in order to make it uniform with the background, enables one to state positively (from comparison) that neither the image of the specimen itself nor any point of its outline has ever been interfered with by retouching or any other process ; more particularly does this apply to the external (concave) margin of the palm, where two or three spines are obviously and clearly visible. In April 1923 I had many opportunities of examining the specimen, and was always able to see the spines, whether by means of a lens or a dissecting microscope, exactly as in the photograph in question." Dr. Quastel also testifies that the copy represents the state of the specimen when it was photographed in Vienna. There seems, therefore, to be no doubt of the genuineness of the negative and photograph. Moreover, many other zoologists had examined the specimen during its stay in England, some of whom Prof. MacBride gives a list of in a recent letter to me (dated February 26, 1926, Imperial College of Science, South Kensington, London) : E. Boulenger, H. M. Vevers, Cannon, F. S. Harmer, J. Stanley Gardiner, Borradaile, and F. Potts.

Further proofs that the Alytes in question has borne nuptial callosities in the epidermis may be found in the microscope sections of the skin that had been removed from the same specimen during the height

of the breeding season from the other (right) hand. The comparison both of Kammerer's pictures in his original paper (*A. f. Entwickl. mech.*, 45, 323, 1919, Pls. x., xi.) or in his "Inheritance of Acquired Characteristics," Boni and Liveright, New York, 1924 (Figs. 10-11, facing p. 62) and of the section photographed in America with nuptial pads of other Anura, show clearly that the callosities differ from all other known pads, resembling most those of other Discoglossidæ, as Bombinator, but still *Discoglossus pictus* (after Lataste; see Kammerer, 1924, Fig. 11 N. 3). This had already been pointed out by Mr. Perkins (NATURE, August 18, 1923, p. 238). Lastly, it may be mentioned that quite recently the possibility of Alytes developing nuptial pads has been shown in a specimen found in Nature and examined by R. Kändler (*Jenaische Z.*, 60, 175, 1924, Pl. 10, Fig. 12). Although it is only just a beginning of callosities in one male taken in Westfalen (Germany), when compared with the usual smooth surface of the Alytes hand it becomes significant. Kändler found the callosities in this one male on the palmar and dorsal side of the thumb, on the inner side of the third and fourth finger. The callosities resemble those which Kammerer figured for the F_2 generation of water-bred Alytes (*l.c.* Pl. xi. Fig. 4). There were no typical nuptial pad-glands Kändler also questions if those described by Kammerer were of this character, as Kändler's females showed the same type of gland with granular content too. But no females showed callosities. Kändler has also figured the nuptial pad of other Anura, *i e. Bombinator igneus* (Pl. 10, Figs. 8A, 9). This figure is in accordance with that of Lataste.

Whilst it is possible to come to a probable solution with respect to the spiculæ, we have not been able to elucidate the origin of the black substance. It is clear that it has nothing to do with the black pigment often seen in nuptial pads of Anura other than Alytes, or with the patches described and in the progeny of non-egg carrying Alytes males by Kammerer, 1909. The only possibility we can think of is that some one has tried to preserve the aspect of such black nuptial pads in fear of their vanishing by the destruction of the melanin through exposure to the sun in the museum case, by injecting the specimen with India ink. Kammerer himself was greatly astonished at the result of the chemical tests, and it ought to be stated that he had been asked and had given his consent to the chemical investigations. He would suggest that somebody had made such injections to get him into difficulties were it not that he remembers the black substance to have been in the same place and amount even in the living animal (letter to Przibram, February 18, 1926). So the case remains obscure.

We may conclude as a result of these observations:

(1) The only one of Kammerer's specimens of Alytes still preserved is not valid as a proof of the nuptial pads, at least not in its present state of preservation.

(2) No asperities are to be seen now, but by photographs taken before the specimen was sent to England it must be inferred that the spiculæ have been lost through the shaking of the voyage and repeated handling.

(3) Photomicrographs of the sections said to have been prepared from the skin of the same specimen some time before its preservation in the height of the breeding season show in several points different characters from nuptial pads of other Anura, even of Bombinator, coinciding more closely with those of Discoglossus (next relative to Alytes), and the picture of a rudimentary nuptial pad found on a male Alytes in Nature by Kändler (1924).

(4) The black substance in the whole specimen has nothing to do with melanin and is not restricted to a nuptial pad region.

(5) With this conflicting evidence it is greatly to be desired that the experiments of Kammerer on Alytes may be taken up again by some one of equal skill in rearing Anura

The Progress of Geological Survey in Great Britain.

THE area described in the first [1] of the Memoirs of the Geological Survey of Great Britain referred to below lies in Ross-shire and Sutherland The north-western corner is occupied by Lewisian, Torridonian and Cambrian rocks, all of which have been involved in the great Caledonian thrusts of the N.W. Highlands. Of special interest are the alkaline igneous rocks of Loch Ailsh. They form a composite laccolith of post-Cambrian and pre-thrusting age, made up of types ranging from perthosite (a new type composed principally of perthite) to pyroxenite, and resembling in many ways the well-known Oslo suite of rocks made classic by Brögger. Convincing evidence is adduced to show that the alkaline character is original, and quite independent of the intimate association of the intrusion with the Cambrian dolomites. Another feature of petrological importance is the description of the newer igneous rocks, which here present clear evidence of permeation and hybridisation.

The area dealt with in the second memoir [2] in our list, Golspie, lies to the east of the preceding, and includes the coast of Sutherland from Dornoch to Helmsdale. The earlier chapters are devoted to the physical features, and to the schists and gneisses belonging to the Moine series and the older and newer igneous rocks associated with them. The marginal complex of injected and other metamorphic rocks around the Rogart granite is fully described, and hybrids like those alluded to above also occur. The Old Red Sandstone covers considerable areas in the sheet, and along a narrow coastal strip Mesozoic rocks are present, ranging from the trias to the Kimeridgian. The final chapter gives an account of glacial phenomena, peat deposits, and raised beaches.

Iona and Staffa are visited every summer by an increasingly large number of tourists, and those who are interested in geology will appreciate the publication of a Memoir referring to this region.[3] Those who are not will become interested despite themselves, for the islands abound in geological features which are part of their attraction. The famous Ardtun Leaf Beds and Macculloch's Tree are fully described; and the columnar basalts of Fingal's Cave and other parts of Staffa are discussed on the lines followed in the recent Memoirs on the Isle of Mull.

The account of the geology of the extreme north of England given in the Memoir on Berwick and the neighbouring country [4] is welcome as a sign that the

[1] The Geology of Strath Oykell and Lower Loch Shin. (Explanation of Sheet 102 of the Geological Map of Scotland.) By Dr. H. H. Read, J. Phemister and G. Ross, with contributions by C. H. Dinham and M. Macgregor. Pp. vi+220+2 plates. 6s. net.

[2] The Geology of the Country around Golspie, Sutherlandshire. (Explanation of Sheet 103 of the Geological Map of Scotland), including a description of the Mesozoic Rocks of East Sutherland and Ross. By Dr. G. W. Lee, Dr. H. H. Read, G. Ross and J. Phemister. Pp. vi+143+1 plate. 3s. 6d. net.

[3] The Geology of Staffa, Iona, and Western Mull. (A Description of Sheet 43 of the Geological Map.) By E. B. Bailey and E. M. Anderson, with contributions by G. A. Burnett, J. E. Richey, Dr. G. W. Lee, W. B. Wright and G. V. Wilson, and Petrological Notes by Dr. H. H. Thomas. Pp. iv+107+1 plate. 3s. net.

[4] The Geology of Berwick-on-Tweed, Norham and Scremerston. (Explanation of New Series One-inch Sheets 1 and 2.) By A. Fowler. Pp. ix+58+2 plates. 1s. 6d. net.

re-survey of Northumberland is now well under way. The chief points of interest are the descriptions of the Scremerston coalfield and the very striking coast sections to the north of the Tweed. Memoirs on the sheets to the south are due for early publication, and should be of importance in so far that they will contain references to the northern boundary of the Whin Sill. It is in itself significant that this Memoir, the first of the promised series, contains no mention of any igneous rocks.

The greater part of the Pottery coalfield of North Staffordshire is included in the sheet described in the Memoir on Stoke-upon-Trent.[5] An account of the coal measures with their important coal seams and iron ores naturally takes first place. There is also a valuable chapter on faults and folds; and as a feature appearing for the first time in this edition, descriptions of the post-Triasic Bullerton dyke and of the other intrusions of the area are given. It is interesting to notice that Dr. Scott, who has studied the Tertiary and Carboniferous alkaline rocks of Scotland, directs attention to the petrological affinities of the former with the intrusive rocks of North Staffordshire. He thinks that the Rowley Regis and Clee Hill rocks are likely to be also of Tertiary age.

Passing now to Epping Forest and the eastern suburbs of London,[6] we find only Eocene, Pleistocene and later deposits. The Chalk, however, underlies the whole area, and the question of deep-seated water supplies is discussed, and illustrated by a contour map of the sub-Tertiary Chalk surface. On the south the subsoil consists mainly of the deposits made by the Thames; the central part is chiefly London clay; while to the north the region is diversified with hills capped with Bagshot sand and glacial deposits. These beds are discussed with special reference to sanitation and agriculture.

[5] The Geology of the Country around Stoke-upon-Trent. (Explanation of Sheet 123.) By Dr Walcot Gibson, with contributions by C. B. Wedd and Dr. A. Scott. Third edition. Pp. vii+112. 2s. 6d. net.

[6] The Geology of the Country around Romford. (Explanation of Sheet 257.) By H. G. Dines and F. H. Edmunds. Pp. xiii+53+2 plates. 1s. 6d. net.

London and Edinburgh: H.M. Stationery Office; Southampton: Ordinance Survey Office, 1925 and 1926.

Air Pollution and its Prevention.

THE citizens of Leeds, under the auspices of the Mayor and City Council, have instituted a campaign against smoke to commemorate in a practical form the tercentenary of the granting of the statute to the city. In connexion with this effort, a pamphlet entitled "Clean Air for Leeds" has been prepared by a Committee, of which Prof. J. B. Cohen is chairman, formed on the invitation of the Lord Mayor to consider the question of "a cleaner city on the lines of smoke abatement." The pamphlet has been prepared for free distribution, and aims at informing the public as to the present condition of the smoke problem.

Leeds is to be congratulated on facing her own smoke problem in this way. A visitor, unless from another Midland city, cannot help being struck by the prevailing sooty blackness of the buildings. It is surely a merciful provision of Nature that people adjust themselves so easily to environment; had this not been so, life in some of our smoke-blackened cities must appear scarcely worth living. It is, however, this adjustment to environment which blinds our eyes more or less to the true condition of affairs. Leeds has a useful field for effort here. The pamphlet gives a short analysis of the problem of smoke abatement and the remedies available. The sources of air pollution, cause, nature, and effects of smoke are all dealt with briefly.

The general conclusions of the Departmental Committee on Smoke Abatement are quoted, and it is clear enough that this committee had no hope of a solution of the problem by the initiative of local authorities unless subject to the stimulus of Government. The new Bill now before Parliament must provide the necessary stimulus or it will not go very far towards a solution.

The Leeds pamphlet should be of great use in keeping the problem before the public mind. Reference is made on page 24 to the standard gauge used by the Advisory Committee on Atmospheric Pollution, and the Leeds committee criticises this gauge on the grounds that "the amount of solid matter is largely dependent on the situation with regard to the wind and the nature of the ground on which the gauge rests." The Committee then proceeds to recommend a method devised by Prof. Cohen many years ago, involving the exposure, in different localities, of glass plates, upon which some of the deposited matter adheres. These plates are afterwards washed in running water under a tap, and the deposit estimated by its opacity, or other means. The Advisory Committee, we believe, had this method before it when considering the most suitable means for measuring deposited impurity, and the method was discarded as not fulfilling the necessary conditions. While the exposed plate method has all the drawbacks attributed by the Leeds committee to the standard deposit gauge, it has also others of its own, which influenced the Advisory Committee in deciding to adopt the gauge method. The plates cannot be any more independent of position or wind than the gauges, while the deposit retained by the plates is not the total but some unknown and variable fraction of it, depending on the stickiness of the deposit, whether the plates are wet or dry, the weather, and so on. It may also be supposed that a plate which has received a first deposit of tarry soot will be more effective as a trap than one which starts with a less sticky layer of ash or grit. The only sound procedure is to catch in some way the whole of the deposit—hence the Advisory Committee's standardised gauge.

It is to be hoped that Leeds will not depart from this method of measuring deposit, as a great part of the value of the results lies in their being comparable with those from other cities.

The open coal fire is discussed in the pamphlet, and the conclusion is given that raw coal cannot be burnt in an open grate without the production of smoke. The use of smokeless sources of heat is recommended, of which gas, coke, and electricity are specifically mentioned and discussed. The advantages of the gas fire, its cleanliness and cheapness, are referred to, while the use of coke in domestic fires is advocated; but, as the pamphlet goes on to say, "it is not every kind of fireplace nor every kind of coke which is suitable for burning in an open fire." The relative costs of heating by coke, coal, gas, and electricity are discussed; the figures arrived at indicate coke to be much the most economical source of heat.

A section at the end deals with the law relating to the smoke nuisance, and the new Government Bill is discussed. The committee, in its final recommendations, lays great stress upon the need to educate the public in the use of smokeless methods, and, on the whole, it is to be congratulated on its public-spirited efforts to clean the air of Leeds.

University and Educational Intelligence.

Cambridge.—The trustees of the Busk Studentship in Aeronautics, founded in memory of Edward Teshmaker Busk, who lost his life in 1914 whilst flying an experimental aeroplane, have awarded he studentship for the year 1926–7 to Mr. P. B. Walker, of Peterhouse.

London.—The Rogers Prize of 100*l.* for 1926 has been awarded to Dr. Robert Coope for an essay entitled "The Value of the Various Methods of Investigating Diseases of the Pancreas."

The University Studentship in Physiology for 1926–1927, of the value of 50*l.* and tenable for one year in a physiological laboratory of the University or of a school of the University, has been awarded to Mr. E. T. Conybeare, who proposes to undertake research in physiology at Guy's Hospital, particularly on the clinical side, and possibly also to extend his work on anæthesia in relation to its clinical application.

The University College Committee will shortly appoint either a full-time assistant or two part-time assistants in the Department of History and Method of Science. Candidates must be graduates either in biology, or in physics, or in astronomy. A good working knowledge of at least two foreign languages is desired.

Miss Helen Masters has been appointed Head of the Domestic Science Department and the Training College for Teachers of Domestic Science of the Battersea Polytechnic, London, S.W.11, in succession to Miss Marsden, who is retiring after nearly twenty-seven years' service. Miss Masters holds the King's College Post Graduate Diploma in Household and Social Science, and has been, for the past fifteen years, on the staff of the Household and Social Science Department of King's College and has acted as examiner in domestic science for the University of London.

The secretary of the Council on Medical Education and Hospitals of the American Medical Association has contributed to *School Life* for April an article on "Rural Schools as Centres of Medical Service and Community Life." The position of the country doctor in the United States has for many years been becoming more and more precarious owing to an increasing tendency on the part of residents in country districts to resort to town practitioners. Meanwhile the rural school consolidation movement has been proceeding apace. The consolidated and improved rural school has definitely proved its worth and gone far beyond the experimental stage. The plan, which is being rapidly adopted throughout the States, involves the transportation of pupils from all parts of a large district to and from the consolidated school in motor omnibuses, and this makes it necessary also that the roads leading to the school from all directions should be kept in fair condition. "Why," asks Dr. N. P. Colwell, the writer of the article, "should not the locations of these schools become rural community centres for other than educational purposes?" A health centre or clinic either in the school or in a separate building could serve not only the children attending the school but also other people living in the district, and the motor omnibus service could doubtless be induced to co-operate. Such a scheme, either by itself or in conjunction with a guarantee by a number of influential residents, would, it is suggested, suffice to secure for the district the services of a competent physician.

Contemporary Birthdays.

August 10, 1865. Sir Charles Frederick Close, K.B.E., F.R.S.
August 10, 1862. Prof. William Joseph Hussey.
August 11, 1852. Prof. Harold Baily Dixon, C.B.E., F.R.S.
August 12, 1860. Sir Sidney Gerald Burrard, K.C.S.I., F.R.S.
August 13, 1861. Prof. Herbert Hall Turner, F.R.S.
August 13, 1879. Dr. Philip Gosse.

Sir Charles Close, formerly an officer in the Royal Engineers, was Director-General of the Ordnance Survey from 1911 until 1922. He is an active general secretary of the International Geographical Union.

Prof. Hussey, director of the Detroit Observatory of the University of Michigan, was born at Mendon, Ohio. From 1911 until 1917 he was director of the Observatorio Nacional de La Plata, Argentina. He has done excellent work in choice of sites for observatories in Southern California, Arizona, and Australia, working for the committee on observatories of the Carnegie Institution. Prof. Hussey was awarded the Lalande prize of the Paris Academy of Sciences in 1906 for double star discoveries and investigations. He is a foreign associate of the Royal Astronomical Society.

Prof. H. B. Dixon was educated at Westminster School and Christ Church, Oxford. His life's work was carried out at Manchester as occupant of the chair of chemistry in the University there, in succession to Sir Henry Roscoe. The Royal Society awarded Prof. Dixon a Royal medal in 1913, on the ground of his eminence in physical chemistry, especially in connexion with explosions in gases. He was president of the Chemical Society, 1909–11. Prof. Dixon, it may be recalled, was president of the chemical section at the last meeting of the British Association held in Oxford, namely, that in 1894. He gave an address on "An Oxford School of Chemists."

Sir Sidney Burrard was Surveyor-General of India from 1910 until 1919; formerly he held office as Superintendent of the Trigonometrical Survey of India at Dehra Dun. Whilst in charge he was responsible for the success of the most extensive system of geodetic triangulation ever inaugurated. His works on the geography and geology of the Himalayas and Tibet (in conjunction with the late Sir Henry Hayden); on the effect of the Himalayas on the plumb-line in India; and on isotasy, have given him special repute as a scientific investigator.

Prof. Turner was born at Leeds, and was educated at Clifton College, and also at Trinity College, Cambridge. Formerly chief assistant at the Royal Observatory, Greenwich, he was next appointed Savilian professor of astronomy in the University of Oxford. He has done yeoman service for the British Association, having been one of the general secretaries from 1913 until 1922. He was president of the Royal Astronomical Society, 1903–5. Prof. Turner is Hon. D.Sc. Leeds and Sydney, and a corresponding member of the Paris Academy of Sciences.

Dr. Gosse is the grandson of that engaging personality, Philip H. Gosse, F.R.S., who died in 1888, author of works on marine zoology, and on the microscope. Educated at Haileybury and St. Bartholomew's Hospital, Dr. Gosse is assistant superintendent of the Radium Institute. He acted as naturalist to the FitzGerald expedition to the Andes (1896).

Societies and Academies.

PARIS.

Academy of Sciences, June 28.—A. **Lacroix**: The fused veins of meteorites and their analogy with the 'pseudotachylites' of distorted terrestrial regions.—Charles **Moureu**, Charles **Dufraisse**, and Paul Marshall **Dean**: A dissociable organic peroxide: rubrene peroxide. The hydrocarbon rubrene described in an earlier communication, when exposed to sunlight in benzene solution, rapidly absorbs oxygen, thereby losing both colour and fluorescence. From the solution a white crystallised product containing solvent of constitution is obtained, which dissociates on heating into solvent, rubrene and oxygen. It is pointed out that the existence and dissociation of this peroxide is of great theoretical interest.—Léon **Guillet**: The cementation of steels by silicon. The object of these researches was to obtain a film of high silicon steel on a mass of mild steel retaining the mechanical properties of the mild steel with a chemically resistant skin. In all of the experiments cited the cemented skin was too fragile.—**Neymann**: The laws of probability which tend towards the law of Gauss, remaining infinite in the neighbourhood of a point.—Jules **Drach**: The integration of the equations $r+f(s, t)=0$.—Silvio **Minetti**: The radius of convergence and the singularities of a class of analytical functions defined by Taylor's development.—R. **Gosse**: A special class of equations of the form $s=f(x, y, z, p, q)$.—G. **Alexitch**: Conjugated trigonometrical series.—André **Charrueau**: Some geometrical properties of surfaces of equilibrium relative to a liquid mass of revolution, in uniform rotation round its axis of revolution.—J. **Villey**: A simple model of electrometer of low capacity.—H. **Pelabon**: Detection (of electromagnetic waves) by metallic contacts. A symmetrical detector. A stable detector can be made from two steel balls of the same diameter (3 cm.) suspended from an insulating support by copper wires 15 cm. long. The effect appears to be independent of the nature of the interposed dielectric.—**Volmar**: The photolysis of the alcohols. The photochemical decomposition of the alcohols under the influence of the radiation of the quartz mercury vapour lamp takes place in two stages, the dehydrogenation of the alcohol giving aldehyde and ketone and the photolysis of the latter.—Henri **Belliot**: Experiments on photographic inversion.—Victor **Henri** and Sv. A. **Schou**: The ultra-violet absorption spectrum of the vapour of formaldehyde. New type of spectrum of Y-shaped molecules. The movements of rotation of an asymmetric molecule possessing three unequal moments of inertia cannot be resolved mathematically, but when two of the moments are equal an expression for the energy of the molecule can be found (Sommerfeld, Born, Reiche). The vapour of formaldehyde is composed of such molecules, and a study of the absorption spectrum shows that its structure corresponds very exactly with the formulæ for symmetric molecules having two different moments of inertia. Other substances which may be expected to show similar spectra are phosgene, thiophosgene, acetone.—**Consigny**: The influence of metallic screens on the form of the ionisation curves of the α-rays.—R. **Mellet** and M. A. **Bischoff**: Chemical reactions and volumetric titrations in Wood's light. The fluorescence of the solution is used as the indicator; possible uses of the method are given.—M. **Bourgeaud**: The electrometric study of the allotropic forms of mercuric sulphide.—P. **Job**: Some applications of the spectrographic method to the study of complexes in solution. The substances examined were a solution of iodine and potassium iodide in alcohol, potassium mercurichloride in aqueous solution, and the double bromide of cadmium and potassium. In the first of these the iodide of potassium behaved as though present in triple molecules, giving the complex $(KI)_3$.—J. **Errera**: The polarisation of a medium and its molecular structure. The electrical moments of the dihalogen derivatives of benzene.—Edmond **Vellinger**: The rotatory power of organic bodies as a function of the *p*H: glucosamine. A curve is given showing the rotatory power of glucosamine as a function of the *p*H. It resembles the curve obtained by Mlle. Liquier for asparagine. A formula is developed from theoretical considerations which corresponds closely with the experimental results.—A. **Travers** and **Houot**: The tempering of type-metal alloys. The dilatometric study of monotype and stereotype alloys shows clearly, after three months, the influence on these alloys of time elapsed after tempering. The contraction appears to be mainly due to the proportion of tin.—G. **Flusin** and H **Giran**: The estimation of calcium carbide in calcium cyanamide. The acetylene produced by the action of water on the calcium carbide present is passed into ammoniacal silver nitrate solution, the mixed precipitate of silver acetylide and sulphide treated with hydrochloric acid, the chloride dissolved in ammonia, and the solution titrated with standard potassium cyanide.—A. **Kirrmann**: Magnesium reactions starting with 1:3 dibrompropylene. The reaction of this dibrompropylene with methyl magnesium bromide is very complex, and the following products have been isolated: ethane, erythrene, bromobutene, octadiene, and a hydrocarbon which is probably $C_{10}H_{18}$.—Paul **Baud**: The pulp of the agave as a source of industrial alcohol.—P **Idrac**: Records of the electrical field of the atmosphere up to a height of 20,000 metres. Results of experiments made at the Trappes Aerodynamical Observatory with captive balloons There are some irregularities, but on the average the electrical field decreases up to 9000 metres. The mean result gives a field of 10·4 volts per metre at 4000 metres, 5·6 volts at 6000 metres, and 2·3 volts at 8000 metres. At higher altitudes the values are much higher, being 30 or 40 volts per metre in the neighbourhood of the isothermal layer (10,000 to 12,000 metres).—Georges **Corroy**: The Spiroferideæ of the European Lias.—H. **Colin** and A. **de Cugnac**: The various types of the grass family according to the nature of their reserves of hydrocarbons.—S. **Metalnikow** and V. **Chorine**: Conditional reflexes in immunity.—A. **Alivisatos** and Fernand **Mercier**: The action of crystallised violet on the cardio-vascular apparatus of the dog. Crystallised violet (hexamethylpararosaniline chloride) appears to act on the heart in a manner resembling the digitalis alkaloids. It exerts a stimulating action on the pneumogastric nerve, to which is added a specific action on the myocardium, producing an augmentation of the tonus and energy of the heart.—J. J. **Thomasset**: The presence of cells in the dentine of some elasmobranchs.—Paul **Chabanaud**: The frequency, symmetry and specific constancy of external hyperostoses in various fishes of the family of Sciænoides.—P **Portier**: The genesis of the secondary nucleus of natural pearls.—Mme. Anna **Drzewina** and Georges **Bohn**: The action of metallic silver on the sperm and larvæ of the sea urchin. A discussion of the sterilising action of silver vessels.—H. **Barthélemy**: Biometrical and experimental researches on the hibernation, maturation, and supermaturation of *Rana fusca*.—A. **Vandel**: The relations between sexual reproduction and parthenogenesis in the terrestrial Isopod *Trichoniscus* (*Spiloniscus*) *provisorius*.

CAPE TOWN.

Royal Society of South Africa, May 19.—E. L. **Gill**: An early embryo of the blue whale. The embryo was taken from a blue whale (*Balænoptera sibbaldi*) at Saldanha Bay and is at the stage reached by the human embryo at about the twenty-eighth day. Though still in the main a generalised vertebrate embryo, it shows hints of cetacean characters in the small eye, large jaw elements, short neck and reduced branchial arches, large genital papilla, and close segmentation. The fore-limb bud is large, but there is no visible trace of a hind limb. In size (about 6·5 mm.) it agrees closely with other embryos of the higher vertebrates (*e.g.* chick, rabbit, man) at the same stage of development.—C. von **Bonde** and D. B. **Swart**: The structure of the plathander (*Zenopus lævis*) (Pt. i.). The animal presents many primitive features, being related ecologically with the Dipnoi and morphologically with the Anuran and Urodelan amphibia. Notable points with regard to the external features are (*a*) the abundance and properties of the secretion of the slime glands; (*b*) the presence of definite groups of dermal sense organs; (*c*) the presence of an eye tentacle in the adult; (*d*) the cloacal lips in the female.—L. **Mirvish** and L. P. **Bosman**: Note on the calcium content of blood. The effect of the injection of extracts of various body tissues, including ovarian and luteal extracts, upon the calcium content of blood has been examined.

SYDNEY.

Linnean Society of New South Wales, April 28.—J. **McLuckie** and A. H. K. **Petrie**: An ecological study of the flora of Mount Wilson. (Part iii.) The vegetation of the valleys. The plant communities represented are the Ceratopetalum-Doryphora association, the *Eucalyptus goniocalyx-E. Blaxlandi* association, the *Eucalyptus piperita* consociation, and the *E. hæmastoma* var. *micrantha* consociation.—C. **Barnard**: Preliminary note on branch fall in the Coniferales. The development of foliar shoots and the associated shedding of branches can be correlated with the phylogeny of the tribes of the conifers. The presence of distinct dimorphism in the branches of conifers seems to be a primitive feature, gradually lost in higher types.—H. J. **Carter**: Revision of the Australasian species of Anilara (Buprestidæ) and Helmis (Dryopidæ), with notes, and descriptions of other Australian Coleoptera.

VIENNA.

Academy of Sciences, June 10.—R. **Weiss**, A. **Spitzer** and J. **Melzer**: On tri-phenyl-methanes, the benzol nuclei of which are bound to each other (ii.) Trimethylene - triphenylmethane - triketondicarbon-acids.—O. **Wettstein**: A new race of mice in Austria, *Evotomys glareolus ruttneri*.—O. **Koller**: Two new forms of fish from the Island of Hainau, a species of Cyprinid and a subspecies.—J. **Schorn**: History and results of seismology in Northern Tyrol.—A. **Defant**: Primary and secondary, free and forced, pressure waves in the atmosphere.—A. **Schedler**: Air pressure waves and correlations over the North Atlantic Ocean.—A. **Roschkott**: Studies on oscillations of air pressure in the region of the Azores highlands.—F. M. **Exner**: Relations of air-pressure anomalies on the earth to each other.—R. **Rotter**: On condensations of unsaturated compounds with diazo-methane.—F. **Knoll**. The differential geometry of the spacial vector field.

WASHINGTON, D.C.

National Academy of Sciences (Proc. vol. 12, No. 6, June).—William **Hovgaard**: Bending of a curved tube of circular cross section. A formula is developed which when applied to pipe bends gives results in good accord with experiment.—E. O. **Salant**: The heat capacity of solid aliphatic crystals (ii.).—R. J. **Havighurst**: (1) The effect of crystal size upon the intensity of X-ray reflection. With a crystal having a linear dimension greater than 10^{-5} cm., intensity is modified by 'extinction,' which may be primary (due to each little block acting as a perfect crystal) and secondary (due to shielding of the inner blocks by those near the surface). Work on powdered sodium chloride, calcium fluoride and calcite indicates that primary extinction is absent in crystals grown from solution and less than 10^{-3} cm. in thickness, so intensity measurements can be used to determine electron distributions. Single crystal measurements of the alkali halides require correction for secondary extinction. (2) The intensity of reflection of X-rays by lithium, sodium and calcium fluorides. Measurements of intensity enable the relative value to be calculated of a factor, the "atomic structure factor," which at small angles of reflection approaches the number of electrons in the atom. This factor is plotted against sin θ (where θ is the angle of reflection) and, finally, atomic scattering curves are drawn; those for fluorine from the different salts are nearly alike, suggesting a force field of constant magnitude, while those for sodium from the chloride and fluoride differ considerably. The total number of electrons gives only a rough idea of the order of the atoms as regards scattering power.—J. H. Van **Vleck**: Note on the postulates of the matrix quantum dynamics. The Hamiltonian equations, the commutability relations, the Bohr frequency condition and the conservation of energy equation can be taken as the fundamental postulates. The Ritz combination principle and the quantum conditions become not merely *sufficient* but also *necessary* for the last two postulates.—Joseph Miller **Thomas**: Conformal invariants. A complete set of integrability conditions which express the laws of transformation of a set of conformal invariants are obtained.—Helen **Barton**: Generalisation of Kronecker's relation among the minors of a symmetric determinant. Kronecker's relation is a special case of a more general relation.—Oliver D. **Kellogg**: On the classical Dirichlet problem for general domains.—Ernest W. **Brown**: The evidence for changes in the rate of rotation of the earth and their geophysical consequences (*v.* NATURE, July 31, p. 170).—Christine **Ladd-Franklin**: The reddish blue arcs and the reddish blue glow of the retina: seeing your own nerve currents through bioluminescence. A band of bright red light thrown on a screen in a dark room appears to have slightly reddish-blue arcs projecting from it on both sides. What is seen, as an entopic phenomenon, is certain fibres of the optic nerve on the surface of the retina. These fibres, when stimulated, seem to give off an 'emanation' which causes fluorescence in the retina.—Thorne M. **Carpenter**: The metabolic effect of enemata of alcohol, dextrose and levulose in humans. Ethyl alcohol is rapidly and nearly completely absorbed; it promotes the elimination of water without removing other constituents of the tissues, increases pulse rate and lowers the respiratory quotient, indicating that alcohol is utilised in the tissues. Dextrose and levulose are not absorbed so rapidly or completely, the respiratory quotient increases with the former, indicating increased utilisation of carbohydrate. Levulose caused the greatest decrease in nitrogen elimination. It is suggested that, administered by rectal injection, these substances are metabolised throughout the body in a manner similar to that in which material is utilised in muscular work.

Official Publications Received.

Statens Skogsförsöksanstalt. Skogsförsöksanstaltens Exkursionsledare, 11: The Experimental Forests of Kulbäckslidén and Svartberget in North Sweden. 1: Geology (Description and Maps), by Olaf Tamm; 2: Vegetation (Description and Maps), by Carl Malmström. Pp. 87. 2 kr. Statens Skogsförsöksanstalt Flygblad, No. 35: Skogsträdens Fruktsättning år 1925. Av Gösta Mellström Pp. 22. Skogliga rön, No. 4: Några Riktlinjer för Torrläggning av Norrländska Torvmarker. Av Carl Malmström. Pp. 26. Skogliga rön, No. 5. Ett Observandum vid Skogsodlingar. Av O. Eneroth. Pp 7. (Stockholm: Centraltryckeriet.)

Ministerio da Agricultura, Industria e Commercio: Directoria de Meteorologia. Boletim Meteorologico, Anno de 1921: Observações meteorologicas feitas no Observatorio do Instituto Central, do Rio de Janeiro, e nas Estações da rêde Nacional. Pp. vi+159. (Rio de Janeiro.)

Report of the Director of the Royal Observatory, Hongkong, for the Year 1925. Pp. 16. (Hongkong.)

Proceedings of the Royal Society of Edinburgh, Session 1925–1926. Vol. 46, Part 2, No. 21: The Slow Oxidation of Phosphorus Trioxide. Part 2: The Production of Phosphorus Tetroxide by direct Oxidation of Phosphorus Trioxide By Dr. Christina Cruickshank Miller. Pp. 239-244. (Edinburgh. Robert Grant and Son; London: Williams and Norgate, Ltd.) 9*d*.

Transactions of the Royal Society of Edinburgh. Vol. 54, Part 3, No. 13: A Study of the Hokien and the Tamil Skull. By Prof. Gordon Harrower. Pp. 578-599+1 plate. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 4*s*. 6*d*

Regenwaarnemingen in Nederlandsch-Indie. 1: Java en Madoera, 1923. Pp. 127. (Weltevreden: Landsdrukkerij.)

Transactions of the Royal Scottish Arboricultural Society. Vol. 40, Part 1, March. Pp. x+69+26+4 plates. (Edinburgh: Douglas and Foulis.) 3*s*.

Proceedings of the United States National Museum. Vol. 68, Art. 17: The Minerals of Obsidian Cliff, Yellowstone National Park, and their Origin. By William F. Foshag. (No. 2618.) Pp. 18+4 plates. Vol. 68, Art. 18: Revision of the American Leaf Hoppers of the Jassid Genus Typhlocyba. By W. L. McAtee. (No. 2619.) Pp 47+6 plates. Vol. 68, Art. 19. A Revision of the American Lice of the Genus Pediculus, together with a Consideration of the Significance of their Geographical and Host Distribution. By H. E. Ewing. (No. 2620.) Pp. 30+3 plates. Vol. 68, Art. 22: Descriptions of new West Indian Longicorn Beetles of the Subfamily Lamiinae By Warren S. Fisher. (No. 2623.) Pp. 40. Vol 68, Art. 24: A Collection of Pleistocene Vertebrates from Southwestern Texas. By Oliver P Hay. (No. 2625.) Pp. 18+8 plates. (Washington, D.C. Government Printing Office.)

Verhandlungen der Schweizerischen Naturforschenden Gesellschaft. 106 Jahresversammlung vom 8 bis 11 August 1925 in Aarau Pp. 141+187+54. (Aarau. H R Sauerlander et Cie.)

Aeronautical Research Committee. Reports and Memoranda, No 992 (Ae. 203): The Measurement of Torque Grading along an Airscrew Blade By Dr. G. P. Douglas and L P. Coombes. (A.3.d Airscrews 83 –T 2102.) Pp. 11+10 plates 9*d*. net Reports and Memoranda, No. 994 (Ae. 205): The Variation of the Performance of an Aeroplane with Wing Loading. By W. S. Farren. (D1. Special Technical Questions 142—T. 2128 and A.) Pp. 22+10 plates. 1*s* 6*d*. net Reports and Memoranda, No 1002 (Ae. 210). An Experimental Investigation into the Properties of certain Framed Structures having Redundant Bracing Members Report No. 4. By Prof. A. J. Sutton Pippard and G. H W. Chitty. (B 2.g. Strength and Design-General, 68—T. 2189.) Pp. 11+2 plates 6*d*. net. Reports and Memoranda, No. 1003 (M. 33): On the Concentration of Stress in the Neighbourhood of a small Spherical Flaw; and on the Propagation of Fatigue Fractures in 'Statistically Isotropic' Materials. By R V. Southwell and H. J. Gough. (M.C. 27.) Pp. 22+3 plates. 1*s*. 3*d*. net. Reports and Memoranda, No 1005 (E 17): Note on 'Detonation' Temperatures in Closed Vessel Explosions, by R. W Fenning. Work performed at the National Physical Laboratory for the Engineering Research Board of the Department of Scientific and Industrial Research. (I.C.E. 519.) Pp 4+1 plate. 6*d* net. (London: H.M. Stationery Office.)

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Department of the Interior Bureau of Education. Bulletin, 1925, No 43: Motivation of Arithmetic. By Prof. G. M. Wilson Pp iii+60. (Washington, D.C.: Government Printing Office.) 10 cents.

Smithsonian Miscellaneous Collections. Vol 78, No. 2: Mexican Mosses collected by Brother Arsène Brouard. By I. Thériot. (Publication 2867.) Pp. 29 (Washington, D.C.: Smithsonian Institution.)

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League of Nations Health Organisation: Malaria Commission. Report on the First Results of Laboratory Work on Malaria in England. By Dr. S. P. James, assisted by P. G Shute. (C. H./Malaria/57 (1).) Pp. 30. (London: Constable and Co., Ltd.)

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Nyasaland Protectorate. Annual Report of the Geological Survey Department for the Year 1925. Pp. 7. (Zomba.)

Mines Department. Fourth Annual Report of the Safety in Mines Research Board; including a Report of Matters dealt with by the Health Advisory Committee, 1925. Pp. 63. (London: H.M. Stationery Office.) 1*s*. net.

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Report for 1925 on the Lancashire Sea-Fisheries Laboratory at the University of Liverpool. Edited by Prof. James Johnstone. Pp. 63. (Liverpool: University Press of Liverpool, Ltd.; London: Hodder and Stoughton, Ltd.) 2*s*. 6*d*.

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Abisko Naturvetenskapliga Station. Observations météorologiques à Abisko en 1923. Rédigées par Bruno Rolf. Pp. iv+68. Observations météorologiques à Abisko en 1924. Rédigées par Bruno Rolf. Pp. iv+66. (Stockholm.)

Meddelanden från Statens Meteorologisk-Hydrografiska Anstalt. Band 3, No 8: Zur Thermodynamik der Kondensation an Hygroskopischen Kernen und Bemerkungen über das Zusammenfliessen der Tropfen. Von Hilding Köhler Pp. 16. 1 kr. Band 3, No. 9: Mälarens vattenstånd åren 1887-1925. Av Folke Bergsten. Pp. 20. 1.50 kr. (Stockholm.)

Smithsonian Institution: United States National Museum. Contributions from the United States National Herbarium. Vol. 22, Part 9: Studies in American Phaseolineae. By C. V. Piper. Pp. viii+668-701. (Washington, D.C.: Government Printing Office.) 10 cents.

Report of the Aeronautical Research Institute, Tokyo Imperial University. No 16. Some Experiments on Motion of Fluids, Parts 1, 2 and 3 By Torahiko Terada and Kunio Hattori Pp. 87-112. 1.20 yen. No. 17: Linien konstanter Strömungsgeschwindigkeit Von C. Wieselsberger. Pp 115-125. 40 sen (Tokyo: Maruzen Kabushiki-Kaisha.)

The Quarterly Journal of the Geological Society Vol. 82, Part 2, No. 326, July 3rd. Pp. 101-331+plates 7-21. (London: Longmans, Green and Co., Ltd.) 7*s* 6*d*.

Russian Society of the Amateurs of the Universe's Knowledge (Mirovedenie): Bureau of Scientific Observations. Report on the Phenological Observations from 1925. (In Russian.) Pp. 63-98. (Leningrad.)

The Institute of Physics Report of the Board for the Year 1925. Pp. 16. (London.)

Board of Education Report on the Science Museum for the Year 1925. Pp. 24. (London. H M. Stationery Office.) 1*s* net.

Diary of Societies.

AUGUST 6 TO 11.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (at Oxford).

Friday, August 6.—At 10 A.M.—Addresses by Sectional Presidents. G.—Sir John Snell: The Present and Future Development of Electricity Supply. L.—Sir Thomas Holland. Discussion (Section C): Problems of the Thames Gravels.—Discussion (Section M): Agricultural Education.

At 11 A.M.—Discussion (Section L): Scholarships

At 11.30 A.M.—Addresses by Sectional Presidents: D. Prof. J Graham Kerr: Biology and the Training of the Citizen.—J.—Dr. J. Drever: Psychological Aspects of our Penal System.—Discussion (Section K): Sex Determination in Plants.

At 2.30.—Discussion (Section I): The Relationship of Vitamin B to Bios.—Discussion (Section L). The Cinema in Education.

At 3.15.—Discussion (Section I): The Meaning of the Symptoms of Beri-beri.

At 3.30.—Discussion (Section L): Wireless in Education.

At 8.—Prof. A. S. Eddington. Stars and Atoms (Evening Discourse).

Monday, August 9.—At 10 A.M.—Addresses by Sectional Presidents: A.—Prof. A Fowler. The Analysis of Spectra.—H.—Prof. H. J Fleure: The Regional Balance of Racial Evolution.—M.—Sir Daniel Hall: The Limits of Agricultural Expansion.—Discussion (Section B): Tautomerism.—Discussion (Section L): Recent Advances in Educational Science.

At 11 A.M.—Discussion (Section K): Vegetative Propagation.—Discussion (Section D): The Training of a Zoologist.

At 2.—Discussion (Sections D, H, J): Heredity in its Physical and Mental Aspects.

At 8.—Prof. H F. Osborn: Discoveries in the Gobi Desert by the American Museum Expeditions (Evening Discourse).

Tuesday, August 10.—At 10 A.M. Prof. J. S. Huxley: The Study of Growth and its Bearings upon Morphology (Lecture).—Discussion (Section L). The Public School System.

At 11 A.M. Discussion (Sections C, D, K): The Conception of a Species.

At 11.30 A.M. Discussion (Section M): The Feeding of the Dairy Cow.

At 12 noon.—(Section I) by Dr. J. S. Haldane: Acclimatisation to High Altitudes (Lecture).

At 2.—Conference of Delegates of Corresponding Societies.

At 2.30.—(Section J) by Miss W. Spielman: Recent Progress in Vocational Selection (Lecture).

At 5.—Sir F Keeble: The Nervous System of Plants (Lecture).

Wednesday, August 11.—At 11 A.M.—Discussion (Section E): Regional Work in Geography.

At 12 noon.—Concluding General Meeting.

SATURDAY, AUGUST 14, 1926.

CONTENTS.

Economics of the Coal Industry.

MR. FRANK HODGES recently addressed the Royal Society of Arts upon the all-important subject of the economics of the coal industry, and his very thoughtful and well-reasoned address may be unreservedly recommended to all interested in the matter, that is to say, at this moment to every thinking man throughout Great Britain. The authoritative statistics which Mr. Hodges produces show more clearly than words the basal reasons for our difficulties, and most of them are summed up in the following quotation:

"The Ruhr hours are 8 hours for each man, and those of Upper Silesia, in Poland, are 8½ hours for each man. Wages costs in Great Britain are per ton 12*s.* 3*d.*; in the Ruhr they are 7*s.* 10*d.*; and in Poland 3*s.* 8*d.* The wages of all persons employed in British mines are 10*s.* 5*d.*; in the Ruhr 7*s.* 4½*d.*; in Polish Upper Silesia 3*s.* 6*d.* per shift.

The latest figure of output per shift in Great Britain was 18·4 cwts.; in Germany 21 cwts.; in Upper Silesia 22·06 cwts."

Mr. Hodges points out the inevitable result of these figures, namely, that in the coal export trade "Great Britain has lost both relatively and absolutely in the coal business of the world." It is not so many years ago since a general strike in Great Britain would have produced something like a panic, not only in this country but also throughout industrial Europe, which at one time was practically dependent upon Great Britain for its coal supplies. To-day, Europe cares nothing whether the British coal mines are working or idle; nay, more, the rest of the world is quite capable of supplying British needs. Mr. Hodges points out cogently that this unpleasant fact is due to our high prices and low output per man. He does not deal with the contributory cause, namely, that British coal miners have by repeated strikes taught the rest of the world how to do without British coal. It is because of these strikes that other nations have been forced to develop their own coal resources as well as other sources of power, notably water power, which have replaced British coal. A notable example in point is Switzerland, which has developed its hydro-electric powers and electrified its railways, mainly because, as a Swiss engineer put it, they are determined to have a source of power that *will not go on strike.*

The point cannot be too strongly stressed that a definite proportion of the old-time export coal trade of Britain is gone for ever. The only way to secure some share in what is still left is to bring down British prices of coal production to a competitive basis. Mr. Hodges seems to think that some relief may be obtained by a better use of the coal so as, in his words, to "bind

up production of the raw fuel with the production of electricity and gas and by-products." At best, however, this remedy can only be a palliative; however well the coal is utilised when it is produced, nothing will ever avail to counterbalance the cardinal fact that British coal costs too much to produce. Other nations can use coal as effectively as we can, and if they produce it more cheaply than we do, they will still be ahead of us in world competition. In justice to Mr. Hodges, it must be said that he appears to appreciate this fact, and is clear on the point that the only remedy is lower wages or longer hours of work. He has come to the conclusion that, of the alternatives, "a modification of hours . . . is the least of two evils." His proposed remedy is a 45 or 46 hour week; it is highly probable that many of those who have studied the subject carefully will scarcely be inclined to agree with him that this is going quite far enough, or to hold, as he does, that if the working week is increased to 48 hours, other countries in Europe will increase their hours also. This proposition may well be doubted in view of the fact that wages per hour in Britain are practically twice as high as they are even now in the Ruhr.

There will no doubt be a general consensus in favour of Mr. Hodges' suggestion that there should be a five-years' agreement in order to get the industry back on to a sound basis. He realises quite clearly that reorganisation of the collieries, where such is required, cannot be done without an influx of fresh capital, and that to get such an influx, terms acceptable to the capitalist must of necessity be offered. Mr. Hodges, like every other intelligent man, sees that British coal miners must accept the inevitable, and that it is useless to fight against natural laws and economic facts. Our only hope of salvation lies in producing coals more cheaply; whether the coal miner prefers to attain this end by working longer hours or by accepting lower wages, is a question which he ought to be allowed to decide for himself. One or other alternative, or a compromise involving something of each, is the inevitable solution, and it is for the coal miner to say which he prefers. If neither is accepted, then we must be prepared to contemplate an end to British coal mining.

The Protection of Wild Life in Australia.

Save Australia: a Plea for the Right Use of our Flora and Fauna. By various Writers. Edited by Sir James Barrett. Pp. viii+231. (Melbourne and London: Macmillan and Co., Ltd., 1925.) 8*s.* 6*d.* net.

THE march of civilisation inevitably betokens the retreat of the native plants and animals of a country. For long the retreat passes unnoticed: the early settlers, battling with Nature for a foothold, have little inclination to survey any but the most immediate effects of their handiwork, and it is left for their more leisured successors to develop the æsthetic sense which laments the disappearance of the primeval natives of the land. It is on this account the more gratifying to find that a comparatively new country like Australia, with its unique fauna and flora, has tackled the problem of its disappearing animals and plants with an energy which puts to shame the puny efforts made in the 'old country.'

Four main causes are said to account for the disappearance of Australian animals. Two are inevitable, and are practically beyond the modifying power of man. (1) His settlements and cultivation open up the country at the expense of the shelters, the feeding-places and the breeding-places of many of the wild animals. (2) Epidemic disease may sweep with dire effect through the populations of large areas, as in 1898-99 and 1901-2-3, when koalas, dasyures, certain bandicoots and other forms were almost exterminated in a tract from central Queensland to Victoria. The other two causes are looked upon as equally serious, and they are preventable. (3) The deliberate introduction and setting free of such aliens as the fox, the cat, the rabbit, and many species of European birds has, either by direct destruction or by the consumption of the food supply and occupation of nesting sites, played havoc with many of the natives. Mr. Le Souef alleges that the fox has cleared off practically all the small ground animals outside the coastal districts in eastern and southern Australia, and the immunity of the inhabitants of the coastal districts is due to the presence of the poison tick, *Ixodes holocyclus*, which is fatal to foxes and dogs. (4) Deliberate destruction for the fur trade is making heavy inroads upon the native stock. From 1919 to 1921 the exported pelts of a few typical animals were: opossum, 4,265,621; ring-tailed opossum, 1,321,625; koala, 208,677; wallaby, 1,722,588. There is at present no control of, or any check upon, such exports, and slaughter on such a scale can end only in virtual extermination. Some half-dozen marsupials in Western Australia are now on the verge of extinction, though their disappearance cannot readily be attributed to man's interference.

Each of the Australian States has set about protecting its own fauna in the only way in which a fauna can be adequately safeguarded, that is, by the creation of reserves in which the animals are immune from any but controlled interference. The reserves are created by the legislature, but the system of control lacks unity, in so far as it is vested in two or more independent departments of the State, while in many places the

difficulty of policing large areas with inadequate staffs plays into the hands of unscrupulous collectors. There is something to be learned, however, from the graded system which has been adopted, and of which the Western Australian reserves may be taken as examples.

Here there are four types of State-protected areas, differing a little in stability, in the primary purposes for which they were created, and in control. Class A Reserves comprise national parks, sanctuaries for native plants and animals, and cave and scenery reserves, so created that they cannot be alienated except by special Act of Parliament, an unlikely event in the present state of public feeling towards the protection of wild life. The ordinary reserves, for the preservation of the native fauna and flora, are under the control of the Ministry of Lands, and are less assured in standing, since they may be alienated by the Governor and Executive Council, without reference to Parliament. Mr. W. Catton Grasby, however, is of opinion that most of these will ultimately become permanent Of these two types, in Western Australia alone there are some forty reserves, covering in all an area of more than a million and a quarter acres. In addition to the set reserves there are forest reserves, under the Forestry Department, and game sanctuaries (thirty-six in number) under the Fisheries Department, in each of which protection is enforced.

Queensland has well over a hundred sanctuaries, including such large areas as Hinchinbrook Island (97,280 acres), Bellenden Ker Reserve (70,000 acres), and Stradbroke Island (78,720 acres); New South Wales possesses about fifty reserves, the largest of which is practically the whole of Cumberland county, with its two National Parks, specially patrolled; and each of fifteen principal sanctuaries in South Australia represents a fair-sized area of country.

The legislation adopted for the protection of native animals differs in the different States. In some (*e.g.* Western Australia) a long list of protected animals and birds is scheduled, and there even the owner of land cannot take or kill except under certain specified conditions, the general principle being laid down that all native game, whether on Crown lands or not, is the property of the Crown. Queensland, on the other hand, through its Department of Agriculture and Stock, has adopted what is known as the "black list" system, the names of non-protected creatures being listed, while emphasis is laid on the fact that all other "wild animals and birds" are totally protected throughout the whole year. Already every Queensland trapper has to obtain a permit, and every 'bird and animal' dealer a licence.

Another noteworthy step in the progress of Australian protection was marked by the passing in 1912 of a special Act for the conservation of the native flora of Western Australia. It is a model of thoroughness. Scheduled trees, shrubs and plants may not be destroyed or mutilated on Crown lands or lands reserved. No flowers that bear evidence that the plant from which they were taken was mutilated may be sold or exposed for sale. The police may examine and retain such flowers and plants, and the Government railways may refuse to carry them.

Thanks to the efforts of the Australasian Association for the Advancement of Science, the Royal Societies of South Australia and Western Australia, and other learned bodies, backed by strong public opinion, steps have been taken which should go a long way towards conserving the native fauna and flora for all time, so far as conservation lies within the power of man. These fine efforts make a strange contrast with the indifference of the British legislature to the native animals and plants of Great Britain, the existence of many of which is even more seriously threatened. The law has made not a single effort to protect our unique or disappearing plants, fishes or mammals, except in a statute, precariously renewed year by year, on behalf of the grey seal. Surely the time is approaching when the State, following the lead of its own colonies and of almost every other nation in the world, must cease leaving to private ownership the responsibility of safeguarding our native possessions, and must take steps, by creating national reserves or otherwise, to perpetuate the interesting fauna and flora as well as the notable Nature monuments of Great Britain.

JAMES RITCHIE.

The Peoples of Northern Nigeria.

The Northern Tribes of Nigeria: an Ethnographical Account of the Northern Provinces of Nigeria, together with a Report on the 1921 Decennial Census. By C. K. Meek. Vol. 1. Pp. xviii + 312 + 61 plates. Vol. 2. Pp. viii + 277 + 25 plates. (London: Oxford University Press, 1925.) 36*s*. net.

THE facts embodied in this book were for the most part collected during the census of 1921, though they have very little to do with the ideas that are commonly attached to the word 'census,' for the officers concerned were encouraged to combine with their statistical work as much ethnological investigation as was possible. Mr. Meek thus had an immense amount of territory to cover, and this presumably is the reason for the somewhat scrappy quality of much of the work, as well as the difficult and even illogical arrangement of the chapters. This said, there is little but praise for the book, which brings a large number

of new facts before the anthropologist for comparative use, and may for years be trusted to act as a dictionary which should be put in the hands of every officer in Northern Nigeria.

After a short account of the anthropo-geography of the country, extending over an area of some two hundred and fifty-four thousand square miles, the author, having mentioned some of the chief tribes, considers the 'racial elements' composing them: Negro, Hamite, Semite, with perhaps an evolving Semito-Negroid, which he thinks may in time become a definite type. The Nupe and the Yoruba are recognised as having a non-negro element, while among the negroes great diversity appears in the physical characters. Thus the brachycephalic Bantu-speaking Bafum from the Cameroons are almost pygmies, and the tall massive Jukun seem to approximate to the tall Nilotes of the Sudan. With such extremes, and with so little knowledge of the tribes, the author was probably wise to adopt a temporary classification based on language. A chapter headed "History and Tradition" is to be taken in its broadest sense; beginning with palæoliths, and including celts and arrow-heads, it continues with a discussion of objects which are certainly no later than Muhammadan times. Mr. Meek pays considerable attention to early foreign influence, and here perhaps is at his least critical: "Objects dug up in the Yoruba country by Frobenius have been dated by Egyptologists as belonging to the sixth century B.C." Again, "Egyptian goods had penetrated to Kordofan as early as 3000 B.C."; *i.e.* in common chronology, in proto-dynastic times. Surely all this requires revision? On the other hand, the author's treatment of Muhammadan history and tradition is excellent, and makes clear the complicated relations which have brought about the present condition of the northern Muhammadan states —Bornu, Kano, and Sokoto.

This roughly covers the first half of the first volume; then come chapters on technology—including an account of glass-making—followed by others on social organisation. The first chapter of the section headed "Social Organisation" is devoted to animal and plant taboos. Here the author points out that these beliefs occur among the Muslim as well as the pagans:

"Animal tabus are universal in Nigeria . . . Muslim families still have their sacrosanct animals. They are known in the *lingua franca* as *kan gidda*, which means 'the head' or 'the source of the house.' Muslims have told me that the totem witnessed the foundation of the house. They will not usually go so far as to say that their family was actually descended from the totem, but I have known professing Muslims who said that the totem contained the spirits of their forefathers. The *kan gidda* is . . . the family badge. The species is sacrosanct; it is therefore never eaten (any one inadvertently eating the flesh of his totem would immediately vomit). The revered animals are usually non-domestic, but no Zaberma will eat the camel's flesh, and the Toronkawa—a Fulani Muslim sub-tribe to which belongs the royal house of Sokoto—abstain from the flesh of goats. . . . Thus . . . in spite of their professed religion, many Muslim tribes retain a strong sense of mystic relationship with their totemic animals."

Among the pagan, perhaps the most interesting examples of animal taboos are those connected with the leopard. Thus among the Longuda—

"certain individuals who believe themselves immune from attack by leopards will refrain from eating leopard's flesh, though they will take part in a leopard hunt. A Wukari Jukun who kills a leopard parades the town with the dead animal mounted on a mat. The people salute the animal with the uplifted arm as they would a chief. Though the slayer of the leopard is given numerous gifts, he is nevertheless required to perform propitiatory rites, which include three days' solitude in the bush."

Rites indicating the royalty of the leopard also occur in East Africa; *e.g.* among the Acholi.

Mr. Meek's suggestion that the term 'animist' should be substituted for pagan does not seem very desirable, while with regard to the names of the different forms of cult of the dead, it seems doubtful whether most of these do not interdigitate in one tribe or another. A considerable number of tribes worship the sun, and of these Mr. Meek states:

"The Sun is their Supreme Deity, the All Father, the Giver of Rain, the Ripener of Crops, but so remote and otiose that he can only be approached through the host of intermediaries already described the spirits of ancestors who dwell near him, and those nature spirits who are demi-gods and his servants. He is too far removed to need the propitiation of sacrifice; but in times of stress his devotees vaguely hold out their hands to him in prayer. The Sun-worshippers seem to regard the Sun primarily as the Ripener of Crops."

The distribution of sun worship in Africa is of great interest, though too wide to be discussed here; but it is noteworthy that, while absent among the Nilotes, traces of it are to be found in the Sudan in the hill districts of Kordofan, while it is well developed in Dar Fung. In addition to the cult of numerous spirits and fetishes, and even personification of qualities (such as hunger among the Waja), the author states that all tribes recognise a supreme deity, remote and not to be approached directly; he is usually sky-dwelling, and is sometimes actually the sun; in some instances he may be considered to have charge of the souls of the dead.

The section on marriage is particularly interesting, though perhaps it is one of the most tantalising in the book; for here are given items of importance from

the marriage regulations of various tribes. Such items are of some value as indicators of custom, but not much more while they remain isolated from the social system in which they occur. However, there is much in the information that Mr. Meek has given to modify the generalisation that he himself has made on the extremely low status of women (cf. pp. 201, 204): that they are mere property to be acquired in marriage, and that the higher the bride-price the lower the status of woman, as an object to be bargained for. Among the cattle-owning tribes of N.E. and S. Africa the reverse is certainly true: a high bride-price is an honour to a woman, and so great is the esteem for cattle, so sacred their character, that the transaction of the bride-price is not really one of purchase at all. It is possible that in Nigeria, where the bride-price is usually paid in cowries or cash, it does more nearly approximate to a purchase; but from the customs that Mr. Meek quotes, it is clear that wives, though they may be inherited, are not treated as slaves, and that the bride-price acts in Nigeria, as it does elsewhere in Africa, as a guarantee of the stability of marriage. Patrilineal peoples usually consider that the bride-price secures the children for the husband, whether he is the actual father or not.

Marriage by exchange, as well as a legalised form of wife-stealing, are described. The former, by which two men exchange sisters instead of paying a bride-price, though found in other parts of the world, is rare in Africa; it has, however, been recorded among the Senoufo of the French Sudan. The function of the extended family, and its bearing on the economic life of the people, is well described. These are factors not usually sufficiently realised by administrators.

The divine character of the king is recognised in Northern Nigeria, and associated with divine kingship are those customs and beliefs that seem to be essential to high authority in Africa. The king is responsible for the rain supply, and the fertility of the land is intimately connected with the king's own virility; hence the king must not be ill or grow old, and so is killed ceremonially either before old age approaches or after reigning a definite period. The most perfect example that Mr. Meek gives is that of the Jukun. Here the king controls the rain; he is so sacred that if he touched the ground with uncovered hand or foot the crops would be blighted. At the end of seven years, at the harvest festival, the king was slain ceremonially (it is interesting to note that quite recently the Jukun chief refused to hold his festival for fear of having to submit to the ancient rite). Two women are associated with the king. One, the king's sister (in the classificatory sense), is also able to control the rain, and is treated with deference by the king himself. The other is the favourite wife of the late king, and is thus the reigning sovereign's official 'mother.' She is consulted on all important matters, and has great privileges; should she not be treated with due respect, the spirit of her late husband would take vengeance on the country. Among several other tribes the divine kingship is quite as definite, though in some cases the king himself takes poison instead of being killed. An interesting case where the rite has become symbolised is given: the Daura have a tradition of killing a dragon, but the dragon's name was Sarki, and the dragon-slayer called Ma-kas-Sarki, Hausa words for 'chief' and 'slayer of the chief.'

There is a section on languages by Mr. N. W. Thomas. The last ninety pages of the work are devoted to the census proper.

The scope of these two volumes indicates the vast amount of anthropological work that remains to be done in Nigeria, and it is to be hoped that Mr. Meek may himself be able to undertake some of it in detail.

B. Z. S.

Upper Air Phenomena.

The Uppermost Regions of the Earth's Atmosphere: being the Halley Lecture delivered on 5 May 1926. By G. M. B. Dobson. Pp. 22+4 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1926.) 2*s*. 6*d*. net.

THE publication of Dr. Dobson's Halley lecture is opportune, since it reviews, in such detail as is possible in small compass, the present state of our knowledge of the constitution of the upper atmosphere and of the chief natural phenomena occurring above the isothermal layer. Some of the phenomena, such as those due to the aurora and to meteorites, are directly visible to the eye, while others, such as the occurrence of ozone and the presence of ionised conducting layers, are appreciated by observation with special apparatus. Apart from the relation between radio and ionisation in the upper atmosphere, the public may find some interest in the fact that the natural phenomena occurring in this region are associated with an important shielding action exerted by our atmosphere, since it is the absorption of the medley of electromagnetic waves and radiations of α, β and γ type, as well as uncharged matter derived from the sun and cosmic sources, which is responsible for the effects observed. The more scientific public will welcome the publication as a concise review of the main facts in a field of endeavour to which Dr. Dobson has made extremely important contributions.

The complete interpretation of the observations demands not only a knowledge of the types of the waves, radiations and matter projected into the

atmosphere, but also of the absorbing material—the density and constitution at great heights. Neither of these two can be calculated unless the temperature is known, as well as the proportion of light gases in the lower layers.

The author deals first with the aurora and considers there is little doubt that it is due to electric discharge caused by charged particles projected from the sun, and points out that a knowledge of the nature and velocity of the radiations would enable more information to be obtained by spectroscopic means about the layers in which they are being absorbed. However, the presence of some lines due to nitrogen has been established, though the origin of the most prominent green line is still the subject of discussion and experiment in cryogenic laboratories. Reference is also made to the measurements of auroral height by simultaneous photographs from widely separated stations (illustrated by photographs), and to the faint green line observed in the light of the night sky and considered to be unconnected with the polar aurora.

The information obtained from observation of the small particles of iron or stony material known as meteors, while being vaporised by the high speed of their travel through the atmosphere, is next considered. Observation at two stations of the apparent path among the stars enables the height of appearance and disappearance, the length of path, speed and brightness to be determined. By calculation from these, it is possible to infer that the temperature of the isothermal layer (about 220° Abs.) continues to a height of some 55 km. in mean latitudes, while the temperature rises to about that at ground level above 60 km. Confirmation of a discontinuity in the atmosphere at this height is given by the fact that very few meteors disappear about the level of 55 km. The suggestion is that this rise in temperature is due to the formation of ozone from oxygen by the action of ultra-violet radiation from the sun, and by the absorption of some of the sun's rays by the ozone so formed. It is the layers ionised by ultra-violet radiation from the sun, and the electric currents set up in these ionised layers by tidal movement of the atmosphere, which are considered to be responsible for the diurnal variation of the earth's magnetic field. Reference is not made to the large variation observed at stations near the auroral zones and its great enhancement in winter on magnetically disturbed days. The importance of this observation lies in the possibility that the ionisation due to the aurora in these zones may be comparable with that due to sunlight—a matter of possible interest in the transmission of radio signals within and across the polar regions.

The author includes brief references to night luminous clouds and the propagation to great distances of the sound caused by large explosions, quoting with approval Mr. Whipple's suggestion that the temperature increase above 60 km. may be responsible for the bending down of the sound waves which have penetrated to this height.

The paper naturally does not discuss in any detail the most recent views regarding the effect of the ionised layers and their height on radio transmission. We can, however, regard it as a matter for congratulation that the increasing use of radio is likely to enhance general interest in the study of those natural phenomena which cause ionisation in the upper atmosphere.

Our Bookshelf.

Allen's Commercial Organic Analysis. Edited by Samuel S. Sadtler, Dr. Elbert C. Lathrop, and C. Ainsworth Mitchell. Vol. 4: Special Characters of Essential Oils; Resins, India-rubber, Gutta-percha, Balata, and allied Substances; the Constituents of Essential Oils, and allied Substances; the General Characters and Analysis of Essential Oils. By the Editors and the following contributors: E. K. Nelson, G. A. Russell, Ernest J. Parry, John B. Tuttle. Fifth edition, entirely rewritten. Pp. x + 648. (London: J. and A. Churchill, 1925.) 30*s*. net.

AN increase of 174 pages in this volume compared with the corresponding volume in the previous edition, published sixteen years ago, gives some indication of the advance in the chemistry of essential oils in recent years. Except for a short section of 55 pages on rubber, this book is practically confined to the subject of essential oils and resins. In its present form it is indispensable as a reference book. With a more intimate connexion between the sections than in earlier volumes, it has been possible to restrict the number of contributors so that more uniformity in the general treatment might be expected. The only British contributor is Ernest J. Parry, the well-known authority on essential oils. He has written the sections on (*a*) resins, (*b*) the constituents of essential oils and allied substances, and (*c*) the general characters and analysis of such substances. His contributions cover more than half the whole book.

The unsatisfactory arrangement in the fourth edition, with special consideration of hydrocarbons and ketones only, has been changed and a more general treatment of the subject given. Some repetition in methods and descriptions occurs and a fair number of misprints and small errors have been noticed. The statement (p. 68) that spike (lavender) oil is dextrorotatory or that West Australian sandalwood oil (p. 133) "is practically identical chemically" with oil from other sources, does not agree with the reviewer's observations. It is hoped that in later volumes improvements may be made in the index, which is not sufficiently complete for a standard reference book, while some attempt might be made to give cross-references to other volumes in the complete work.

J. REILLY.

The Sacred 5 of China is the 5th Book on China. By Dr. William Edgar Geil. Pp. xix+355+56 plates. (London: John Murray, 1926.) 24*s*. net.

As Dr. Geil's title-page indicates, he is the author of several books on China, of which "A Yankee on the Yangtze" is perhaps the best known. In explanation of his present title he says "5 is a number most remarkable to the man of the Central Kingdom." Here he deals with five sacred mountains, the peaks of East, South, Centre, West, and North—Tai Shan, Nan Yo, Sung Shan, Hua Shan, and Hêng Shan—associated with the five elements wood, fire, earth, metal, water, and the colours green, red, yellow, white and black. These mountains are all centres of pilgrimage. Of these sacred sites the importance for the student of Chinese culture lies in the fact that, like similar sites in other lands, they have been regarded as sacred from time immemorial. Like the holy wells of the British Isles, they represent a cult—and preserve survivals of it—which belongs to a stage of development infinitely more primitive than that of the official religion. So, says Dr. Geil, with the sacred mountains of China; beneath the thin rind of Buddhism, and far earlier than Confucianism, is the core with "an immemorial flavour of sanctity, the cult of the mountain spirit."

Dr. Geil, complying with the convention, ascends each mountain in five stages, but his description is not merely topographical or descriptive of the shrines and temples encountered on the way. He gives his readers a selection in each case from the legends, the history, the literature, the elements of ritual and cult associated with each peak, quoting liberally from the classics with such comment as suggests itself by the way. His book may well serve as an introduction to certain sides of the distinctive types of Chinese mentality, delicate in wit and instinct with an intellectuality peculiarly its own. The illustrations are numerous and excellently reproduced.

Die Tierwelt der Nord- und Ostsee. Herausgegeben von G. Grimpe und E. Wagler. Lieferung 2 (Teil 2. d_1, 12. h_1). Teil 2. d_1: *Noctiluca*, von A. Pratje; Teil 12. h_1: *Teleostei Physoclisti*, 10. *Heterosomata*, von W. Schnakenbeck. Pp. 12+60. 4·50 gold marks. Lieferung 3 (Teil 9. c_1, 9. c_2, 12. i_1). Teil 9. c_1: i. *Opisthobranchia*; ii. *Pteropoda*, von H. Hoffman; Teil 9. c_2: *Scaphopoda*, von Tera van Bentham Jutting; Teil 12. i_1: i. *Amphibia*; ii. *Reptilia*, von R. Mertens. Pp. 66+14+20. 7·80 gold marks. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1926.)

EACH group of animals dealt with in this new and admirably planned series is treated along definite lines; first the characters of the animals are described, then their systematic position, in some cases the best methods of fixation, the structure, the distribution, the method and powers of movement, the mode of feeding with details of the physiology of digestion and of excretion and an account of the food, the sense organs, reproduction and development, bionomics and relation to their surroundings with especial reference to parasites. Good bibliographies are provided, while excellent line drawings and maps to show the distribution illustrate the text. As a result of this mode of treatment, we are being provided with a well-balanced account of the fauna of the North and Baltic Seas, compact and yet far removed from the old-fashioned catalogues of genera and species. Points of particular interest, such as light production in Noctiluca, the growth rings on otoliths and scales in fish and the methods of marking flatfish with metal discs, are treated in detail. Further additions to this series will be awaited with interest by all workers in marine biology.

Le tremblement de terre. Par Edmond Rothé. (Nouvelle Collection scientifique.) Pp. xxxiv + 248. (Paris: Félix Alcan, 1925.) 10 francs.

M. ROTHÉ has given us in this little book a very clear account of the latest developments of seismology, especially of the instruments that have been designed for recording distant earthquakes, the methods of locating the epicentre, the forms of seismic rays, and their bearing on the structure of the earth's interior. If it were for these chapters alone, the book would be worth possessing.

The phenomena of ordinary earthquakes are treated at less length, and there are some curious omissions, but the author has wisely chosen in illustration two recent earthquakes that are not likely to lose their interest for many years to come, namely, the Chinese earthquake of 1920 and the Japanese earthquake of 1923. The book is perhaps not altogether well balanced. One could wish, for example, to see less use made of the work of Perrey, Montessus and other French authorities—fully one-third of the references are to French writers—and more to the valuable work done in Italy and Japan. The illustrations are in some cases rough and poorly reproduced, and it is difficult to see the use in a scientific text-book of pictures of Tokyo in flames or of heaps of corpses lying about the streets of the city. The preface, it may be added, contains a brief, though interesting, outline of the history of seismology. C. D.

Migraine and other Common Neuroses: a Psychological Study. By Dr. F. G. Crookshank. (Psyche Miniatures, Medical Series, No. 1.) Pp. 101. (London: Kegan Paul and Co., Ltd., 1926.) 2*s*. 6*d*. net.

THE average general practitioner has little time and opportunity for the study of text-books on the complicated, and in these days bewildering, subject of psychotherapy. To him, therefore, will be of especial value the publication of Dr. Crookshank's two lectures on migraine and other common neuroses. The book is a small one; it can be read in an hour, and the author's style is delightfully attractive. His views—even as expressed in the title—will, of course, arouse controversy, and some of his statements can be described only as startling. His reasoning that the mind may be the deciding factor in the etiology of dementia paralytica, because mental symptoms usually precede the appearance of physical signs, is unconvincing. Yet there is nothing in these pages which the neurologist or psychologist could dogmatically deny; and if the author's efforts to demonstrate the supremacy of the psychological factor in migraine should only turn the attention of physicians to the psychical aspect of all who are sick, the book will have served its purpose.

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

X-Rays—Internal Absorption and 'Spark' Lines.

IN recent work by Mr. A. M. Cassie and myself (now being prepared for publication), it has been possible to study some of the details of the process of 'internal' absorption of an X-ray by the atom in which it is excited. This type of absorption has played an important part in the elucidation of β- and γ-ray spectra, and has been fully discussed, notably by Ellis and Skinner in Great Britain, and by Meitner, de Broglie, Thibaud, and others. An excellent summary of the work on the X-ray side is to be found in Bothe's article in vol. 23 of the new Geiger and Scheel "Handbuch."

In the X-ray domain the effects of internal absorption have been beautifully demonstrated by P. Auger in his Wilson tracks produced by X-rays in heavy gases. Auger's results show that in the K excitation of argon, about 90 per cent. of the fluorescent K quanta are absorbed by the atoms in which they are excited, with emission of tertiary photoelectrons: this "specially privileged" absorption becomes less marked with heavier elements (about 50 per cent. for krypton, and, according to Meitner, about 10 per cent. for elements of atomic number round 85), but is in any case amazingly high.

In our experiments, the secondary cathode rays emerging from a 'target' irradiated by X-rays are drawn out into a magnetic spectrum, and their energies are measured as in earlier work by de Broglie, Whiddington, Robinson, and others. In the present work a great deal of 'white' radiation is allowed to remain in the X-ray beam, and in consequence the fluorescent X-ray spectrum of the target is strongly excited. The corpuscular spectra show many lines which are due to the internal conversion of the fluorescent X-rays, or, alternatively, to radiationless (Rosseland) readjustments within the atom which lead to the expulsion of 'photoelectrons of the second kind.' For brevity these lines may be called 'fluorescent' lines, to distinguish them from the 'normal' lines arising from the external absorption of the constituents of the primary X-ray beam.

There are very many of these fluorescent lines, some of them very faint and difficult to resolve, and the measurements are not yet complete. It is certain, however, that most of these electrons emerge with considerably less energy than would be expected if they came from a normal atom: the deficiency is of the order 50-100 electron-volts—far too big for experimental error. There can be little doubt that they come from atoms which were already ionised, and, therefore, had abnormally high energy levels. This energy defect would be inappreciable in a fast β-ray, and scarcely detectable from the Wilson tracks.

The processes taking place are easily visualised; for example, as a possible sequence we may have in successive stages following the ejection of a K electron from the target—(1) an L_{III} electron falling into the vacant place with emission of a $K\alpha_1$ quantum of fluorescent X-radiation; (2) internal absorption of this quantum, with expulsion of a photoelectron from an L, M . . . shell, either while the vacant place in L_{III} is still untenanted, or after L_{III} has been completed (say by an M electron), but while the atom is still ionised in an outer shell. This is typical of many possible processes of the same kind (cf. Auger, *J. Phys. et le Radium*, June 1925), all leading to atoms which are multiply ionised in their X-ray shells. So far as the final result is concerned, it is immaterial whether this takes place as above, or by way of radiationless changes.

The multiply ionised atoms produced in this way ought to be competent to account for at least some of the abnormal lines observed in nearly all X-ray spectrograms (Coster's 'non-diagram' or Wentzel's 'spark' lines) as faint satellites on the high frequency sides of the series X-ray lines. Wentzel has worked out in detail the theory of these 'spark' lines, on the assumption that they are due to multiply ionised atoms. While there can be no doubt of the essential accuracy of Wentzel's work, the experimental evidence as to the manner in which the multiple ionisation is brought about is still very unsatisfactory (cf. Bäcklin, *Zeit. für Physik*, **27**, p. 30). Dr. Wentzel suggested to me some time ago that my corpuscular spectra might show traces of multiple ionisation produced by a single X-ray quantum, but so far I have got no evidence of this (in any case these lines would be very faint). Internal absorption obviously could not account for the production of spark lines in the K series; that is, it could not be expected to produce atoms in the K^2, KL . . . conditions required by Wentzel—but it certainly could account qualitatively for the existence of L spark lines. As shown in the above example, once the K excitation limit is reached, there will be large numbers of atoms in L^2, LM . . . conditions: this provides a very satisfactory explanation of the effect observed by Siegbahn and Larsson (*Ark. Mat, Ast. och Fysik*, **18**, 1924). These experimenters, investigating the L spectrum of molybdenum with a tube operated at different voltages, found no new spark lines between 4 and 20 kilovolts. At 20 kv. a new line first appeared, and no further line appeared even at 40 kv. 20 kv. is just more than is required to excite molybdenum K, and is certainly insufficient for simultaneous K, L ionisation.

We have obtained direct and very striking evidence of the fundamental difference between internal and external absorption, by experiments in which a thin copper target was exposed under identical conditions to (1) copper $K\alpha_1$ primary rays and (2) white radiation from a molybdenum tube operated at high voltage. In case (1) we get the normal copper L lines, L_I and (L_{II}, L_{III})—the latter pair as an unseparated doublet—resulting from external absorption of the primary copper $K\alpha_1$. In case (2), following the ejection of a K electron, we have internal absorption of the same quantum. The corresponding L lines of the 'fluorescent' spectrum are definitely displaced 0·6 mm. (about 60 to 70 volts) on the plates in the direction of smaller energy, and there is no visible trace of the 'normal' lines. Further—and this is most significant—the intensity ratio is entirely changed: with external absorption of $K\alpha_1$, L_I is slightly more intense than (L_{II}, L_{III}) (cf. Robinson, *Roy. Soc. Proc.*, 1923). In case (2) the doublet (L_{II}, L_{III}) is by far the more intense.

Similar effects have been noticed in β-ray spectra, but in our experiments the phenomenon is naturally under greater control, and the interpretation more direct.

H. ROBINSON.

Physical Laboratory,
The University, Edinburgh,
July 27.

A New Type of Absorption Spectrum: Double Rotational Quantification in Formaldehyde.

THE quantification of the rotational motion of an assymmetrical molecule having three different moments of inertia, J_0, K_0, L_0, is a very difficult problem and has not yet been resolved mathematically. However, if two of the moments are equal, $K_0 = L_0$, the problem lends itself to solution, as has been shown by Sommerfeld, Born, Reiche, and others. The rotational energy of a molecule having an axial symmetry is equal to

$$W_{m,q} = \frac{h^2}{8\pi^2}\left[\frac{q^2}{K_0} + m^2\left(\frac{1}{J_0} - \frac{1}{K_0}\right)\right],$$

where m and q are quantum numbers.

The absorption lines corresponding to the different possibilities of rotational transitions of a molecule of this kind form a very complicated spectrum. This may be represented by the juxtaposition of two systems of parabolic branches:

$$\text{I.}\quad \left.\begin{array}{ll} R(m) = \nu_0 + (c_0 + c_1)m + c_2m^2, & \ldots\ m - \tfrac{1}{2} \rightarrow m + \tfrac{1}{2} \\ P(m) = \nu_0 - (c_0 + c_1)m + c_2m^2, & \ldots\ m + \tfrac{1}{2} \rightarrow m - \tfrac{1}{2} \\ Q(m) = \nu_0 + c_2m + c_2m^2 & \ldots\ m + \tfrac{1}{2} \rightarrow m + \tfrac{1}{2}, \end{array}\right\} q = \text{constant},$$

where

$$c_0 = \frac{h}{8\pi^2 c}\left(\frac{1}{J_0} - \frac{1}{K_0}\right),\ c_1 = \frac{h}{8\pi^2 c}\left(\frac{1}{J_1} - \frac{1}{K_0}\right),$$
$$c_2 = c_1 - c_0,\ c = 3 \times 10^{10}\ \text{cm.}$$

$$\text{II.}\quad \left.\begin{array}{ll} R(q) = n_0 + (\sigma_0 + \sigma_1)q + \sigma_2q^2, & \ldots\ q - \tfrac{1}{2} \rightarrow q + \tfrac{1}{2} \\ P(q) = n_0 - (\sigma_0 + \sigma_1)q + \sigma_2q^2, & \ldots\ q + \tfrac{1}{2} \rightarrow q - \tfrac{1}{2} \\ Q(q) = n_0 + \sigma_2q + \sigma_2q^2, & \ldots\ q + \tfrac{1}{2} \rightarrow q + \tfrac{1}{2}, \end{array}\right\} m = \text{constant},$$

where

$$\sigma_0 = \frac{h}{8\pi^2 c}\cdot\frac{1}{K_0},\ \sigma_1 = \frac{h}{8\pi^2 c}\cdot\frac{1}{K_1},\ \sigma_2 = \sigma_1 - \sigma_0$$

Hitherto, no one has reported an absorption spectrum of this kind, and it is not known if there may exist a double quantification of the rotation of molecules.

We have found that the ultra-violet absorption spectrum of formaldehyde vapour,

H H
C
O

, corresponds exactly to this type of rotational spectrum, with two quantifications.

The absorption spectrum consists of 32 bands situated between 3550 and 2500 Å.U. Each of these bands is formed by hundreds of fine lines. These lines are of two types: type *a* consists of the more intense lines distributed through the whole band. The other type, *b*, consists of a great number of very fine, closely grouped lines forming regular series with accumulations near each line of type *a*.

The molecule of formaldehyde has, to a first approximation, an axial symmetry about the axis passing through the carbon and oxygen atoms. The moment of inertia, J_0, about this axis is expressed by $J_0 = 2 \cdot r^2_0 \cdot m$, where $2r_0$ is the distance between the two hydrogen atoms, and $m = 1{\cdot}66 \times 10^{-24}$ gm. The other two moments, K_0 and L_0, have very nearly the same value. This value depends upon the distance between the carbon and oxygen atoms, and upon the angle, 2α, between the bonds of the hydrogen atoms to the carbon atom, so that $K_0 \gg J_0$.

The physical interpretation of the spectrum is that the stronger lines (type *a*) are produced by rotation about the axis of symmetry, with the smaller moment J_0. The closely grouped fine lines (type *b*) correspond to the rotations about a perpendicular axis with the moment K_0.

The analysis of the distribution of the lines in the different bands has given a very satisfactory confirmation of this interpretation. We have found, for example, for the band $B(\lambda = 3418$ to $3378)$ that the stronger lines form a doublet system of three parabolic branches each, the null-lines being $\nu_0 = 29465{\cdot}1$, $\nu'_0 = 29422{\cdot}0$, $\lambda_0 = 3393{\cdot}85$, $\lambda'_0 = 3398{\cdot}82$ Å.U. intern. vac., and the formulæ of the parabolas

$$\begin{aligned} R(m) &= 29465{\cdot}1 + 35m - 2m^2, \\ P(m) &= 29465{\cdot}1 - 35m - 2m^2, \\ Q(m) &= 29465{\cdot}1 - 2m - 2m^2, \\ R'(m) &= 29422{\cdot}0 + 35{\cdot}5m - 1{\cdot}5m^2, \\ P'(m) &= 29422{\cdot}0 - 35{\cdot}5m - 1{\cdot}5m^2, \\ Q'(m) &= 29422{\cdot}0 - 1{\cdot}5m - 1{\cdot}5m^2, \end{aligned}$$

where $m = 1, 2, \ldots 8$. The correspondence between the calculated and the observed values is very good (Δ'_λ calculated − observed $\pm 1{\cdot}0$ cm.$^{-1}$). The distribution of the intensities is also quite regular and conforms to the theoretical one.

We deduce from these formulæ the following values for the constants:

$$c_0 = 18{\cdot}5,\ c_1 = 16{\cdot}5,\ c'_1 = 17{\cdot}0,$$

and therefore

$$= 0{\cdot}67 \times 10^{14},\ \frac{1}{J_1} - \frac{1}{K_1} = 0{\cdot}60 \times 10^{+40},$$
$$\frac{1}{J'_1} - \frac{1}{K_0} = 0{\cdot}62 \times 10^{+40}.$$

A series of lines of type *b*, distributed in parabolic branches $R(q)$ and $P(q)$, correspond to each line of these six parabolic branches. The value of $\sigma_0 + \sigma_1$ is $2{\cdot}4$ cm.$^{-1}$ with a precision of $\pm 0{\cdot}4$ cm.$^{-1}$.

We have, therefore, $\frac{1}{K_0} = 0{\cdot}04 \times 10^{+40}$.

The two moments of inertia of the normal molecule of formaldehyde are $J_0 = 1{\cdot}41 \times 10^{-40}$ and $K_0 = 25 \times 10^{-40}$. Therefore, the distance between the hydrogen atoms is $2r_0 = 1{\cdot}30 \times 10^{-8}$ cm., and between the carbon and oxygen $1{\cdot}0 \pm 0{\cdot}1$ Å.U. In the molecule of water the distance between the hydrogen atoms is $1{\cdot}64$ Å.U., and in the carbon dioxide molecule the distance between the carbon and oxygen atom $1{\cdot}02$ Å.U.

For the activated molecule we find two values of the moments of inertia: $J_1 = 1{\cdot}56 \times 10^{-40}$ and $J'_1 = 1{\cdot}51 \times 10^{-40}$. The branches R, P, Q correspond to the transitions from the normal energy level to the state with the moment J_1, and the branches R', P', Q' to the transitions from the same normal state to the energy level with the moment J'_1. The distance between the hydrogen atoms is increased by the activation from $1{\cdot}30$ to $1{\cdot}37$ Å.U.

This general structure of a rotational spectrum with two simultaneous quantifications has been observed by us for several other molecules belonging to the type of 'Y-molecules'; for example, phosgene and thiophosgene. Together with Prof. J. Errera, we have found the same type of absorption spectra for different para-derivatives of benzene.

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Surveys of the Great Pyramid.

IN an article in NATURE of December 26, 1925, Sir W. M. Flinders Petrie compares unfavourably the recent survey of the Great Pyramid carried out by Mr. J. H. Cole, of the Survey of Egypt, with his own survey of 1881. He points out that the closing error in the eight angles of Mr. Cole's traverse around the pyramid, which amounts to 9·6 inches, is equal to a difference of 2·7 inches "if on the whole distance." This statement would only be relevant to his argument if the traverse were an open one run, more or less, in a straight line, and if the angular error were located entirely in the initial angle. In fact, when the measured quantities (angles and lengths) are taken as observed, the closing error of the traverse amounts to 0·7 inch, and when the traverse is adjusted to self consistency, the greatest corrections applied are 0·04 inch to a measured length and 2·7 inches to an observed angle.

In Sir Flinders Petrie's book, "The Pyramids and Temples of Gizeh," he explains in Appendix II. the methods he used for determining the precision of his work and for weeding out "occasional errors." In the example he gives, on page 230, the four observations he rejects would have been retained by such authorities as Wright and Hayford or Brunt, who only reject observations the residuals of which are at least five times as great as the probable error of a single observation, unless there are physical reasons (wrong sightings, movement of instrument, etc.) for doubting the work. In the 1881 survey, out of 108 sides of triangles around the Great Pyramid, the mean observations of no less than nine were rejected. This excessive number of rejected observations should never have been tolerated

I have little doubt that the high precision claimed by Sir Flinders Petrie has only been obtained by the unwarranted rejection of observations with large residuals, which has decreased his computed probable error but at the same time has certainly diminished the precision of his results.

Mr. Cole's survey has now been tied up to points O, Q, and W of the 1881 survey. The bronze bolt U has gone but another bolt has been leaded into the same hole in the floor of the south-east corner socket and must agree within half an inch with point U. When the two surveys are fitted together by means of the points common to both, Sir Flinders Petrie's point on the casing edge on the east of the pyramid falls 2·7 inches to the east of the casing edge as surveyed in 1925. The other three points on the casing edge agree within one inch.

Accepting the accuracy of Mr. Cole's survey as deduced from the closure of the traverse, and from our knowledge of the precision of the methods employed, this large discrepancy on the east can only be attributed to an error in the 1881 survey.

In the course of this investigation several discrepancies in Sir Flinders Petrie's work have come to light. For example, the eastern side of the Great Pyramid is given as 9067·7 inches. On Plate X the N.E. socket corner is stated to be 30·2 inches north and the S.E. socket corner 35·5 inches south of the corresponding pyramid corners The eastern socket side should therefore be 9133·4 inches and not 9130·8 inches as given.

Mr. Cole's survey was an attempt to determine the exact shape and size of the pyramid as it was built. Sir Flinders Petrie, on the other hand, reconstructed the pyramid as, in his opinion, it should have been built. He remarks "we only need to compute a square that shall pass through the points of the casing found on each side, and having also its corners lying on the diagonals of the sockets."

This being the case, there is nothing to be gained by dealing with Sir Flinders Petrie's arguments published in NATURE. However, his statement that "it would be easier to achieve equality of length than of level" is, in my opinion, not true.

I therefore conclude that Sir Flinders Petrie's survey of 1881 is not nearly so accurate as he claims, that it contains errors amounting to so much as two inches, and that Mr. Cole's survey, whatever slight inaccuracies it may possess, is the most precise survey of the Great Pyramid that has yet been made.

I agree with Sir Flinders Petrie that it is highly desirable that a survey should be made joining the existing casing edge on to lines laid out close to the base, but this will have to wait until several thousands of tons of debris have been cleared away. I hope this will be done in the near future.

F. S. RICHARDS,
Director, Computation Office.

Survey of Egypt,
El-Giza (Mudiriya),
June 12.

THE first point raised by Mr. Richards refers to my remark that the method of placing a single triangle of survey round a pyramid (as in the 1881 survey) was better than a line of eight lengths of traverse carried on by dead reckoning round the base, as in 1925. The effect of the error being possibly caused in the first of the eight angles, was only stated by me to illustrate the unsatisfactory principle of the method

The exclusion of anomalous observations of five times the probable error is held up as a pattern That would be true enough on a series of 4000 observations. On a series of 100 the limit of normal variation would be much smaller. No arbitrary rule should be followed. I excluded anomalies, one by one, until the whole series became almost normal in distribution. I still think that this is the probable road to the truth. The casual causes were due to lateral lighting and refraction of hot air I prefer not to vitiate results by including anomalies, which are detected by the distribution of errors.

The points O, Q, W, in common on the surveys of 1881 and 1925, are stated to have been now fitted together (without quoting a difference), and the only difference is on a point plumbed up from a deep hole in 1881, which was by no means the same place as was fixed and seen on that base side in 1925. The discrepancy pointed out between the socket length and the base side which was deduced from it, on the east, is due to some misprint or slip in mere addition, and has nothing to do with the accuracy of survey. There is, therefore, no ground for claiming that there are errors amounting to two inches in the 1881 survey.

FLINDERS PETRIE.

Magnetic Susceptibilities and Dielectric Constants in the New Quantum Mechanics.

IT is well known that the conventional quantum theory must be modified in accordance with the matrix dynamics developed by Born, Heisenberg, and Jordan, and by Dirac. The purpose of the present note is twofold, namely: (1) to show that in the new theory the spacial quantisation relative to the applied field has no direct effect on the magnetic susceptibility (or the dielectric constant), and (2) to give the results of the calculation of the dielectric constant of a diatomic gas by means of the new mechanics.

(1) It has been generally supposed that in a gas or liquid the orientation of atoms or molecules is random in the absence of a field, and that consequently there may be a change in the susceptibility when the field exceeds the critical value requisite for spacial quantisation. We shall show, however, that in the matrix theory the susceptibility is the same with spacial quantisation relative to the applied field as with random orientations. Let us first suppose the magnetic body is composed of atomic rather than molecular aggregates (*e.g.* monatomic ions in solution). If a magnetic field is applied along the z-axis, the paramagnetic susceptibility per atom is proportional to the average value of M_z^2/kT, where M_z is the z-component of the resultant angular momentum M. With spacial quantisation we have $M_z = mh/2\pi$, and, if j denotes Sommerfeld's inner quantum number, there are $2j+1$ possible orientations. The average value of M_z^2 is then

$$\frac{1}{2j+1}\sum_{m=-j}^{+j}\frac{m^2h^2}{4\pi^2} = \frac{1}{3}j(j+1)\frac{h^2}{4\pi^2} = \frac{1}{3}M^2,$$

which is obviously the same result as with random orientations. Although the ordinary Langevin formula is thus still applicable even with spacial quantisation, the numerical values of susceptibilities are the same as those calculated by Sommerfeld with the older quantum theory, for his correction factor for the effect of spacial quantisation is the same as the factor by which M^2 differs from $(jh/2\pi)^2$ in the new theory.

The preceding argument can be extended to show that spacial quantisation does not change the susceptibility of paramagnetic molecules, diamagnetic susceptibilities, or the dielectric constant of molecules with an electrical moment, such as HCl. This perhaps explains why Lehrer (*Zeits. f. Phys.*, **37**, 155, 1926), on repeating Glaser's experiments, finds no variation of the diamagnetic susceptibility of argon or carbon dioxide with pressure, and especially why the dielectric constants of polar gases do not ordinarily vary with the pressure or field-strength despite the fact that at atmospheric pressure the intervals between collisions are small compared to the precession period.

(2) Let us suppose we have a non-gyroscopic diatomic molecule with an electrical moment μ in the direction of the axis of figure. Using the amplitude matrices for the rotating dipole given by Miss Mensing (*Zeits. f. Phys.*, **36**, 814, 1926), or by Dennison (*Phys. Rev.*, August 1926) we can calculate the dielectric constant with the perturbation methods developed by Born, Heisenberg, and Jordan. The remarkable result is obtained that only molecules in the state $j=0$ of lowest rotational energy make a contribution to the polarisation This corresponds very beautifully to the fact that in the classical theory only molecules with energies less than μF contribute to the polarisation (Alexandrow, *Phys. Zeits.*, **22**, 258, 1921).

The formula for the polarisation takes the simple form

$$P = \frac{8\pi^2 I\mu^2 F}{3h^2}n(T),$$

where F is the field-strength, I is the moment of inertia, and $n(T)$ is the number of molecules in the lowest rotational state. Here and elsewhere we use the term polarisation in the restricted sense of meaning only the part of the actual polarisation which is attributable to the permanent moment of the dipoles. There is, of course, in addition the 'induced' or 'electronic' polarisation, which is approximately the same for all rotational states and hence independent of the temperature. The ratio of $n(T)$ to the total number N of molecules is given by the Boltzmann formula, and from the asymptotic value of this ratio it follows that at high temperatures our formula for P reduces to the Langevin expression $N\mu^2F/3kT$. This is a much more satisfactory result than in the older version of the quantum theory, in which both the calculations of Pauli with whole quanta (*Zeits. f. Phys.*, **6**, 319, 1921) and of Pauling with half quanta (*Phys. Rev.*, **27**, 568, 1926) yielded results diverging from the classical Langevin theory even at high temperatures.

Similar calculations can be applied to the paramagnetism of molecules, expect that is probably necessary to suppose the molecule gyroscopic. The formula for the susceptibility is then more complicated, as it contains contributions from all the rotational states, but still reduces to the Langevin formula at high temperatues. Details of the calculations will be published elsewhere.

J. H. VAN VLECK.
University of Minnesota.

The Attractions of the Ends of Chromosomes in Trivalents and Quadrivalents.

I HAVE lately investigated the chromosome configurations at the metaphase of the first division in the pollen mother-cells of about sixty species and varieties of plants (including triploids, tetraploids, and $2n+1$ forms). The method used guaranteed perfect fixation, and the homologous chromosomes were usually clearly distinguishable at the metaphase. The following facts have been observed (omitting those few plants in which the pairs of chromosomes at the reduction metaphase were joined elsewhere than at the ends):

(1) In diploids (upper line of Fig. 1) the two

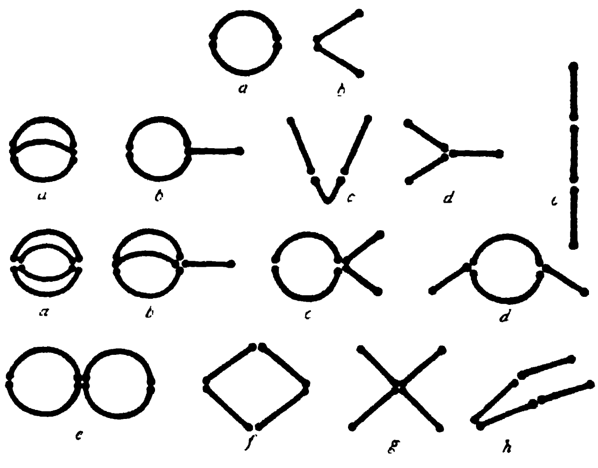

FIG. 1.—Configurations of chromosomes found in diploid, triploid, and tetraploid sets, at the first metaphase of the maturation divisions in the pollen mother-cells.

homologues are nearly always joined at both ends (a). Those joined only at one end (b) are rare.

(2) In triploids (second line of Fig. 1), c is the most common configuration, and together with b and d forms the bulk of the configurations; a being quite rare. This shows either that the combination of *two* chromosome ends is more stable than the combination of *three*; or that the attractions of the chromosome ends are partly neutralised by contact, so that when two ends are combined there is less attraction for a third. Thus the greater number of the junctions in the trivalents are of two chromosome ends, not of three; and in consequence free ends are common.

(3) In quadrivalents (lower two lines of Fig. 1), *e* is the most common form, *b*, *c*, *d*, and *f* being rare. Thus junctions of two ends are as common as those of four or three, and free ends are abundant.

(4) In agreement with these results is the fact that the frequency of separate single chromosomes at the first metaphase is least in the diploids, where they are rare. It is greater in triploids, where separate chromosomes may sometimes occur almost in every other cell. In tetraploids, however, separate chromosomes are usually so common that it often requires a search to find a cell with *n* quadrivalents.

JOHN BELLING.

Carnegie Institution of Washington,
Cold Spring Harbor, N.Y.

Scientific Neglect of the Mas d'Azil.

THE other day in the course of an automobile tour I visited the Mas d'Azil. I would like to direct the attention of the readers of NATURE, and particularly of those with money and organising power, to the very unsatisfactory state of affairs in this beautiful and incomparable treasure-house of archæological material. Practically there is no control, no protection and no organised excavation whatever at Mas d'Azil. There are masses of valuable material, but none of it is being worked at properly. Much of it, I fear, is being wasted and muddled up. There is a 'guide,' a pleasant untrained man, who pokes about in the caves, digs out bones which, as he remarks, fall to pieces, and presents the casual visitor with teeth or flint implements he has found in his own researches. He has no regular salary. He has to supplement his fees and tips by other work. Occasionally, isolated individuals obtain permission from the municipality and prod in the rocks and extract this or that and publish their 'results,' according to their lights. There is a small useless museum without labels or arrangement at the Mairie. The financial situation forbids the hope of Government direction. The essential trouble seems to be the want of funds. From Mas d'Azil came some of the most beautiful and interesting objects in the admirably arranged museum in Toulouse; the carved horse head and other carvings and the painted pebbles from this site are well known. One would not need to go outside the scientific ability available in the region if money were forthcoming to mobilise it for the proper exploitation of these priceless deposits.

H. G. WELLS.

The Eggs of the Pilot-fish (*Naucrates ductor*).

IN *Ann. Mag. Nat. Hist* (9) 2, p. 114, 1918, Dr. Gilchrist described the egg of the Pilot-fish as having a long filament attached to the pole opposite the micropyle, and he states that it serves to attach the egg to the wall of the ovary. Further, the egg was stated to be oval, with a large perivitelline space, but without any oil globule. From the presence of the filaments on the eggs, Dr. Gilchrist presumed that the eggs were attached to floating objects and offered a plausible explanation of the well-known, but hitherto unexplained, habits of the Pilot-fish.

In November last a ripe female of the Pilot-fish was received at this Museum, and I was able to obtain a large quantity of eggs. To my astonishment these eggs differed from those described by Dr. Gilchrist in the two main characteristics mentioned: they possessed no trace of any filaments, but a distinct oil globule was present. On the other hand, they agreed in their more or less oval shape and the large perivitelline space. They floated in sea water. An examination of the ovary disclosed no "grape-like clusters" such as Dr. Gilchrist found, but only the normal structure.

In the case of such a well-known fish as the Pilot-fish, misidentification can be excluded. Another very unlikely possibility occurred to me, namely, that by a slip of the pen *Naucrates ductor* was written instead of *Echeneis naucrates*, the latter fish also being known in these waters as 'Lootsman' and found in association with sharks. To be certain, I examined the Museum material of this and allied species, the eggs of which are apparently still undescribed. Only two females with ripe ova were found and these lent no support to the suggestion of a misnomer having occurred. The ovary showed normal structure and the loose ripe eggs showed no trace of filaments.

The explanation of these diametrically opposed observations can only be found by the study of further material, and it is in the hope that ichthyological students will take the opportunity of examining fresh material and material preserved in Museums, that this letter is written.

KEPPEL H. BARNARD.

South African Museum,
Cape Town, July 19.

Spinning Electrons.

IN view of the recent correspondence in NATURE concerning the spinning electron, it may be of interest to consider the effect of free electrons possessing a magnetic moment on the magnetic susceptibility of metals.

If the magnetic moment of the free electron is one Bohr magneton, and the orientation of its axis with respect to an external magnetic field is assumed to be given by the Boltzmann distribution law, then the paramagnetic contribution to the molecular susceptibility (on the basis of the Pauli-Sommerfeld averaging) will be $1378 \times 10^{-6} P$ at 273° K, where P is the ratio of the number of free electrons per gram-molecule to Avogadro's number. Copper and silver have molecular susceptibilities of $-5{\cdot}7 \times 10^{-6}$ and $-20{\cdot}5 \times 10^{-6}$ respectively. The contribution to the diamagnetic susceptibility of such atoms or ions as may exist in the metal can scarcely be more than $-29{\cdot}8 \times 10^{-6}$ (the molecular susceptibility of Rb^+) in the case of copper, and -37×10^{-6} (Cs^+) in silver.

It must be remembered, in addition, that the normal atom in copper and silver has a magnetic moment of one Bohr magneton. Unless we assume that in the solid metal these elements exist in a form very different from their normal atomic state, and further, that the number of free electrons does not exceed 3 per cent. of the total number of atoms, the hypothesis of the spinning electron leads to some difficulties in understanding the diamagnetism of these metals, and of the alkalis as well.

Since the contribution to the susceptibility of the spinning free electrons would obey the Curie law, namely, that the paramagnetic susceptibility is inversely proportional to the absolute temperature, any considerable contribution to the susceptibility would therefore show itself in a temperature variation in the total diamagnetic susceptibility of a much higher order than that actually found by experiment.

I. I. RABI.

Columbia University,
New York City,
June 22.

Biology and the Training of the Citizen.[1]

By Prof. J. GRAHAM KERR, F.R.S.

I PROPOSE in this address to depart somewhat from precedent, and to devote it neither to a general review of recent progress in our science, nor to the exposition of my own special views on problems of evolutionary morphology, but rather to a more general subject—one which I believe to be at the present time of transcendent importance to the future not merely of our nation but, indeed, of our civilisation—namely, the relation of biology to the training of the future citizen. Speaking as I do from this chair, I need scarcely say that by biology I mean more especially animal biology.

It is unnecessary to emphasise at length the enormously important part which biological science plays in the life of our modern civilised state. The provision of food for the community—crop-raising, stock-breeding, the production of dairy products, fisheries, the preservation of food by canning and freezing, and so on—is obviously an immensely complicated system of applications of biological science. So also with the maintenance of the health of the community—the prevention of disease, much of which is now known to be due to the machinations of parasitic microbes, often transported and spread by other living organisms, and the cure of disease by the modern developments of medicine and surgery—these again are applications of biological science. When we contemplate merely such simple facts known to everyone, when we see to what an extent the results of biological science are woven in and out through the whole complicated fabric of modern civilisation, when we contemplate further the gigantic expenditure in money devoted to the school training of our future citizens, it must surely strike us as an extraordinary fact that biological science enters scarcely, if at all, into the school training of our average citizen.

What I have said indeed applies, if only in lesser degree, to the subordinate position occupied by science as a whole in our school training. In the early stages of human evolution, as we see illustrated on the earth of to-day by those comparatively primitive savages who still remain in the nomadic hunting phase, what we should now call science plays an all-important part in the education of the young individual: he is taught to observe accurately the phenomena of Nature, dead and living, to draw the correct conclusions therefrom, and to regulate his actions accordingly. In our own early history, science undoubtedly played an equally important part in the training of the young. Even down into the Middle Ages it supplied an appreciable part of the curriculum of the educated man, the seven liberal arts of these days containing a large infusion of what we now call science. In later times, however, from the renaissance of classical learning onwards, science has been kept in the obscure background of our educational curriculum, and in spite of much tinkering of detail in recent years, that curriculum continues unchanged in its main features: it remains preponderatingly literary and classical. Even to-day, if we listen to contemporary discussions on education, we commonly hear arguments as to the relative merits of different constituents of the current curriculum, but the general framework of that curriculum seems to be regarded as sacred from all interference.

Yet these recent years have witnessed the most tremendous advances in the evolution of our social organisation, and, as the position now is, it seems as certain as anything can be that unless further advance is accompanied by a corresponding evolution in the training of our future citizens, a condition of instability will soon be reached such as to involve the risk of complete disaster. Probably the factor in our modern social evolution which has brought in its train the greatest danger is the development of what in general terms we may call means of intercommunication—the means by which transport is effected—on one hand of material things, on the other hand of ideas. Primitive man in the hunting phase of his evolution is a nomad, but a nomad within a restricted area: his wanderings are limited by the more or less vague boundaries between his own territory and that of neighbouring tribes. He is entirely dependent for food and raiment upon what Nature provides within these limits: he knows little of the world beyond except that it is peopled by strangers of varying degrees of hostility: his code of ethics is limited by the same boundaries—highly developed as regards intercourse with his own tribe it ceases to exist in his intercourse with those outside. His dominating idea is loyalty to his own kinsfolk and fellow tribesmen, and for this idea he is ready to make any sacrifice.

With advancing evolution, when the communal unit is no longer the clan or tribe but the nation or federation of nations, geographical and political boundaries still exist; but with the evolution of means of transport by road and rail and sea they cease to form impassable barriers—men and goods are able to pass them freely. Of even greater moment to citizenship than the transport of material things is the transmission of ideas. The great developments in this have come about in the first place with the evolution of language, the vehicle of thought, which has rendered possible the transmission of thought from individual to individual. The use of visible material symbols of a lasting kind—whether pictorial or simply conventional, as in modern writing and printing—while facilitating still further the transmission of thought from individual to individual and from place to place, has done far more, for it has enabled the achievements of each generation to be handed on to its successors with a completeness that was quite impossible by the merely spoken word.

While these advances in the methods of transmitting thought have played an all-important part in rendering secure the orderly progress of human knowledge, they have brought in their train, curiously, one of the most potent disturbing factors to the progress of communal evolution. This disturbance is brought about through interference with the workings of one of the great principles of communal evolution—that of leadership.

[1] From the presidential address to Section D (Zoology) of the British Association delivered at Oxford on August 6.

LEADERSHIP.

Already in the primitive tribal community we find this factor at work. Tribes differ in their size and power—their men may number a mere half-dozen or several hundreds—and the main factor in this is the personality of the tribal chief. Among his own men the chief stands out by his capacity, mental and physical: a quick and accurate observer, he is also quick and accurate in drawing his deductions: he is wise, he is rich in knowledge and in its bearings; while alert and quick in decision, he is of steady nerves, has a good sense of balance, and is reliable in emergency. So it is onwards through historical evolution—the chief, the ablest man of his tribe, finds his successors in a long sequence of natural leaders of men.

It is the more modern developments concerned with the transmission of thought—printing, telegraphy, radio telephony, kinematography, and so on—that constitute the great disturbing factor, inasmuch as they have given enormously increased importance to elements of individual personality quite distinct from general strength and capacity, mental and physical. Amongst such elements there stand out conspicuously oratorical power and skill in the method of advocacy. The leader is no longer forced to the front by the sheer power of his outstanding constructive ability; the place of this is to a great extent taken over by the power of effective and persuasive writing and speaking. The most responsible posts in the leadership of the modern State have been rendered accessible to the skilled orator, even though his constructive ability in statesmanship may not be of the highest.

That this development involves serious dangers is obvious; it seems equally obvious that one of the main tasks confronting the community is the devising and setting up of the educational safeguards which alone can be efficient against these dangers. The task will, indeed, be no easy one: it will clearly, for its satisfactory accomplishment, call for the best intellects the community can provide. However great the ability of those to whom the task is entrusted, it will prove one of high complexity and much difficulty; but certain inevitable conclusions seem to be visible, one of the chief of these being the need of drastic cutting down of the number of subjects at present inflicted upon the young citizen in training during his school period. How exactly this is to be done will have to be worked out carefully; but it seems clear that at present an immense amount of time is given, during the early stages of the curriculum, to subjects which might profitably be replaced by others of greater value in mind-training during these earlier stages. If postponed to a later stage of mental development, such subjects can be mastered in a small fraction of the time required in the earlier stages—when, by the way, their prolonged and wearisome study is but too apt to kill effectively all interest on the part of the pupil in the particular subject.

While I am in complete agreement with those who desire to see the school curriculum greatly lightened as regards number of subjects and wish to see 'snippets of many subjects' replaced by more thorough training in a few, my special task now is to urge the necessity of including in the training of every citizen before the completion of his school period at least a grounding in the main principles of biological science.

It is necessary in approaching any such question to keep clear in our minds the two main functions of education: (1) the educative function in the strict sense—the training and development up to the highest attainable level of the brain-power which Nature has provided, and (2) the informative function—the providing the mind with an equipment of information which will be of use to it later on.

SCIENCE AND THE CURRICULUM.

It is again necessary to glance for a moment at the general question of science in relation to education. I am, of course, one of those who believe that the almost complete exclusion of science from the elementary education of the young which has persisted over a prolonged period has been a real tragedy. In the life of the ordinary active citizen, as opposed to that of the mere scholar and recluse, some of the most important faculties are those which training in science is specially adapted to develop. Such, above all, are the powers of accurate and rapid observation, and of the accurate and rapid drawing of conclusions from observation.

I do not, however, wish to press the claim of biology to an important place in the basic stage of school education, which should have to do with the early development of these powers. On the contrary, I harbour no doubt in my mind that the department of science to be used for this purpose is not biology but physical science. For the early training of the powers of observation there are two essentials: (1) that the phenomena observed should be capable of numerical expression to a high degree of accuracy, or, in other words, that they should be measurable; and (2) that a given observation should be capable of repetition over and over again under approximately the same set of conditions. Biological observation fails as regards both of these essentials. When we proceed to apply the method of measurement to something that is alive or that has once been alive, or to some form of vital activity, we find ourselves confronted not with a phenomenon of comparative simplicity, but with a complex of extreme and, in great part, unknown intricacy.

It is rather in the later stage of education—the informative stage—when the individual has already had his powers of observation and reasoning developed in the earlier stages, that biology should be called upon to play its rôle.

What is required is by no means the storing of the memory with a vast array of separate facts. It is rather that the budding citizen should be given a grasp of broad principles, as accepted by the competent authorities of the day. Such broad principles are generalisations from immense masses of detail. The probable soundness of the generalisation is intimately related to the broadness of its basis of fact. It is, of course, impracticable to place before the pupil the entire body of facts that constitute this base, and if it were possible it would be useless, for it is only a master who is able to perceive clearly the relations of superstructure to base. The object of the teacher is then not to attempt the vain task of demonstrating the truth of the general principle in the short period available: such facts as are introduced should serve merely to illustrate the particular principle and facilitate its appreciation.

I know that there are many who will criticise as unscientific and unsatisfactory such a simple manner of approach to general biological principles. They will say you cannot really instil such principles unless you make the pupil go through an elaborate course of laboratory training in dissection and microscopic observation such as we impose upon the specialist student of biology. I do not agree. My experience has been that an audience, whether of youths or of adults, of ordinary average composition such as we get in a public lecture in a big industrial city, appreciates the points and follows the argument perfectly satisfactorily without such elaborate preparation, provided always that the argument is clothed in plain, non-technical English.

BIOLOGY IN THE CURRICULUM.

The question may now be put: What exactly are the biological facts and principles that should be introduced into such a course of instruction?

(1) First, the great fact of evolution. We still see with tiresome frequency in magazine articles the statement that evolution is not a fact, but merely an unproved hypothesis. No doubt it may be said with perfect accuracy that in one sense absolute proof is unknown to science, except in relation to successive steps of an operation in pure mathematics. Taking, however, the word 'proved' as we use it in ordinary life, *e.g.* in relation to a matter inquired into by a Court of Law, then we are completely justified by the data of embryology and palæontology in stating that evolution is a definitely proved fact. The realisation that it is a fact admitted by all competent judges should be incorporated in the mental equipment of every citizen at an early stage of his training.

(2) Secondly, the broad fact of inheritance: the fact that the offspring repeat the characters of the parent—physical, mental, moral—but that this repetition is never so complete as to amount to identity as regards such characters. It is not always realised that, were the repetition actually exact and complete, it would constitute a fact that would shake our whole biological philosophy to its foundations!

The biologist habitually using the 'species' as his classificatory unit involuntarily becomes dominated by his mental picture of the ideal member of the species, conforming exactly to description, and an individual which obviously does not so conform impresses him as a departure from his ideal. He comes in this way to think of variation as being an active positive process by itself, instead of an inherent characteristic of life and of inheritance. It would not occur to him to decry the science of physiology because it does not know the ultimate nature of the phenomena of life with which it deals, but yet he will sometimes attempt to discredit our evolutionary philosophy because it is similarly without any clear idea as to the ultimate nature and cause of the variation which is the necessary accompaniment of life.

This instability of living things which finds its expression in the constantly fluctuating incompleteness of inheritance has to be driven well home—in the first place because it constitutes the raw material of evolutionary progress, and in the second place because its proper appreciation provides the citizen with his surest safeguard against the talk of those who make it their business to belittle, if not to deny, the ever-present differences in the capacities of their fellow-men.

(3) Thirdly and lastly, the fact of the struggle for existence in Nature and the consequent elimination of the less fit. To the biologist and, indeed, to any one who devotes thought to the matter, the struggle for existence and the consequent elimination of the unfit is an obvious truism, apart altogether from the question whether or not he accepts the Darwinian view of its potency as a factor causing evolutionary change; but yet among our fellow-citizens interested in sociological questions there is a very prevalent lack of appreciation of the widespread nature and the intensity of the struggle, induced in many cases by the perusal of charming descriptions of mutual aid in the animal kingdom, combined with ignorance of the fact that such mutual aid is restricted to the individauls of a community, and that it actually constitutes an important factor in rendering the community efficient in holding its own in the struggle with other communities.

When once the pupil has fully grasped the three great primary facts I have mentioned, he can profitably pass on to elementary notions of the biology of communal life. Gateways leading to these may be found by way of the fascinating phenomena presented by communities of social insects such as bees and ants and termites. Still better in some ways is the study of cell-communities, culminating in the immensely complex cell-communities that constitute the bodies of the higher animals. By whichever route, the pupil is easily led to the three great principles of communal evolution: (1) increase in the size of the community, (2) increased specialisation of its constituent individuals, (3) increased perfection of the organisation by which the constituent individuals are knit together into the communal individuality of a higher order. In some animal communities this organisation is of a material kind, the individuals being linked together by strands of living substance, in others the connexion is not material but is of the nature of social interrelationships.

When once these basic principles are clearly apprehended an approach may profitably be made to the study of human society, where the same principles are seen clearly at work—the simple nomadic group with its individuals few in number, showing scarcely any trace of specialisation, and so loosely knit together that they separate from one another under stress of circumstances, such as attack by a hostile tribe—leading up to the complex modern civilised State with its millions of inhabitants, intensely specialised for the performance of the various communal functions, and knit together by an immensely complex social organisation.

THE INTER-COMMUNAL STRUGGLE.

The appreciation of the fact that our civilised community has come about by a long process of social evolution paves the way to an appreciation of the further fact that human societies are still in process of evolution—States becoming larger and larger, the specialisation of their citizens becoming ever more pronounced, their social organisation more complicated—and that here again a great driving force is the struggle for existence, in this case an inter-communal struggle.

It is surely one of the saddest experiences a biologist can have, to live amongst men whose communal evolution has lagged behind, and to see how, unless helped in their struggle with competitors at a higher level of social evolution by some natural protective feature such as geographical isolation or immunity to local diseases, they are doomed to disappear. Innumerable examples of this are seen in the continents of the New World, where the relatively primitive communities of red men have been displaced by whites in a higher stage of communal evolution. The same process has taken place in the past, races that lagged behind in their communal evolution giving place to others more progressive.

The realisation of the importance of this inter-communal and inter-racial competition is of use indirectly as a safeguard against falling into the common error of shutting our eyes to differences—in material interests, in racial prejudices, in religious beliefs—those troublesome factors which, in actual practice, form obstacles of the most serious kind in the way of those who would find in signed agreements between different nations a sure shield against the danger of war.

The Biological Outlook.

Finally, our training, if successful in inducing in our citizen's mind what we may call the 'biological outlook,' enables him to take a fresh and an enlightening view even of that distressful subject, economics. He appreciates more fully how the customary units of the economist, pounds and dollars, are merely tokens with local values dependent on their power of purchase. In a remote spot on the earth's surface, a pile of golden coins becomes merely so much workable material out of which articles useful or ornamental may be fashioned; a bundle of scrip becomes material of possible use for kindling a fire. Their actual value bears no relation whatever to their token value in other circumstances.

Our citizen from his biological view-point looks beyond this veil of make-believe and realises that the true unit of value is the capacity of the human individual. He sees in each individual a biological capitalist. His store of capital may be small or large. It may consist of the precious bullion, intellectual power, or the humbler metal, bodily strength. The store, small or great as it was to begin with, may have been simply left like talents buried in the earth, or by education it may have been increased in amount and coined into the kind of currency, such as skill in handicraft or other form of social activity, which gives it its greatest local value in the community.

To what End?

Now the question may fairly be put: What good would come of it all were the biologist given his way, and his subject, resting on a basis of elementary physical science, accorded the place in the ordinary school curriculum that he claims for it? How might it fairly be expected to work out in practice to the advantage of the community and of the individual citizen?

To attempt to state adequately the answer to this question would exhaust the time not merely of one address but of many, and I can only indicate one or two points which the answer would include. The scientific training we are arguing for would in the first place be a potent power on the side of social stability, inasmuch as it would help to develop the scientific habit of mind with its constant distrust of the ably stated 'case.' There is no more potent defence against the plausible rhetoric of the advocate than infusion of the scientific habit of bringing verbal statements up against the touchstone of actual fact.

With recognition of the principle that the welfare and happiness of the individual citizen is by no means independent of the material prosperity of the community, proper attention would be given to biological economics. It would be recognised that the training of the individual citizen must include the scrutiny of the nature and amount of his biological capital, and the taking of appropriate measures to increase his stock and to ensure its being minted into the most suitable form of currency.

Individual scrutiny would in turn drive home the necessity of confining within as narrow limits as possible the workings of the principle of mass production in education. The application of that principle plays a great part in industry, but its introduction into the sphere of education is apt to be accompanied by forgetfulness that its success in industry is entirely conditioned by one basic factor, namely, uniformity of raw material. Without such uniformity the practice of mass production is recognised as absurd. The clearer realisation how completely wanting this uniformity is in the human raw material on which education works will serve to impress upon us all the desirability of confining mass education within the narrow limits at the commencement of the educational period when it is for practical reasons unavoidable.

The fostering of the biological element in education would do something to quicken into renewed life the primitive relationship of parent and offspring which has tended to become deadened under the influence of modern civilisation and more especially of mass education. The parent would be no longer encouraged to regard his child as merely number so-and-so in a vast number of units poured into the hopper of the educational mill. He would be encouraged to keep up his natural sense of responsibility for the welfare and interests of his offspring—the slackening of which in our present system is responsible for so much that is deplorable—and incidentally he would be stimulated to take a live interest in the education of his children, in the selection of those responsible for the ordering of that education, and in the subject of education as a whole.

This greater interest would lead the parent to a better appreciation of many things connected with education. One of those of which a deeper appreciation is greatly needed has to do with the reciprocal relations of physical and mental deportment. Passing along a city street the biologist is constantly having his attention caught by little peculiarities of attitude and movement which reveal to him the existence of peculiarities of quite another kind—stability or instability of character, mental sluggishness or alertness. He realises to the full the reciprocal relations between mind and body.

The training of the individual to the highest attainable degree of biological aptitude as a citizen involves naturally his relations to other members of the community. He must be fit not merely to play his part as an isolated individual, but also to carry out

smoothly and efficiently his communal activities. As communal evolution progresses, these latter relations become relatively more and more important. In the primitive savage phase the individual is still subject to the ruthless pressure of natural selection. His whole organisation—his bodily health and strength, the acuity of his senses, his mental alertness—is kept up to the highest pitch. As communal evolution goes on, however, the pressure of natural selection becomes modified. In one particular respect no doubt it becomes intensified, for the crowded community provides greatly increased liability to the attacks of pathogenic microbes, and consequently we find active evolution proceeding in the direction of increased immunity to such as are prevalent and dangerous.

While, however, in this particular respect evolution proceeds actively in the more advanced communities, it is not so in other respects. The individual no longer depends on his perfect bodily fitness, on the acuity of his senses, on the alertness of his mind, to survive and reproduce. As a result, as seems beyond question, the individual necessarily deteriorates with high civilisation in his all-round fitness both mental and physical, and this retrogression renders him correspondingly more and more dependent upon the community for his welfare. Emerging from this consideration, we have the conclusion that with higher and higher communal evolution, with more and more intimate dependence of the individual upon the community, we should have greater and greater attention paid in our educational system to these subjects which have to do with the citizen's relations to and duties towards the community—such as discipline, ethics, patriotism and loyalty to country and comrades, and the past history of the community and race.

The last of these, in fact, the history of our own people, is one of the subjects of the present school curriculum which the biologist would be particularly anxious to see retained, and even accorded increased importance. His natural sympathies go out to it, for his own philosophy—evolution—is but history of a larger growth. No doubt he would sometimes wish its teaching to be modified in detail: he would like to have less attention devoted to brawls and murders—on however great a scale—and to have a little space spared for the achievements of science. In my own city of Glasgow I often wonder how much the average child is taught regarding the two great events of the world's history which took place in that city—I mean, of course, James Watt's improvement of the steam engine and Joseph Lister's inauguration of antiseptic surgery.

In these flippant days there is a tendency to scoff at pompous lines regarding 'lives of great men,' and so on; but are we quite sure that our children are not greatly the losers by hearing so little in their school days regarding the dedicated lives of great heroes of science like Darwin or Lister?

In this address, which I must now draw to its close, I have touched upon some of the general considerations which naturally come to the mind of the biologist when he thinks of his subject in relation to this great and, as it has become, vitally important problem of the training of the future citizen. Some matters that at once suggest themselves I have deliberately avoided: eugenics—there are others who speak of that; sex—the whole air is abuzz with discussions on sex. The importance of every citizen being given a little elementary knowledge of the biological aspects of health and disease; the importance of the school paying more attention than it generally does to training the power of prolonged and concentrated effort upon dull bits of work; neither of these points requires any special emphasis.

There are, however, many other aspects of the problem which I refrain from developing, only because forbidden by the tyrant Time. Summing up the more important of these, I would say that the biologist would like to see a movement of our whole educational system away from the merely literary, doctrinaire, academic regions, in which it is apt to be out of touch with the reality of biological fact and practical affairs. He would like to see a far more general recognition of the fact that the primary object of education is to make the individual able rather than learned. A learned individual may be, and often is, a stupid one. And in any case the development and the training of general brain-power fits biologically into the earlier years of life in a way that is not the case with the acquirement of mere learning.

He would regard as another prime object in the training of the citizen the getting him back towards the primitive habit of thinking constantly. The primitive savage is kept constantly alert by ever-present danger. He is constantly thinking about the meaning of what he sees and hears. Civilised man, freed from the stress of savage life, gets into the habit of not thinking. His actions become automatic. He gulps down whatever is served up to him. If he were only to think he would promptly discriminate as to what is worthy of acceptance and what is not.

The biologist would like to see still another reawakening of ancient custom, namely, the more effective shackling of personal liberty in the bonds of duty towards the community. A biologically educated community, while according to the individual in his ordinary affairs the widest range of personal freedom, would take measures to prevent effectively its interference with the public welfare, whatever might be the form of this interference.

There is one other argument I would use for the biological factor in training the citizen. As social evolution progresses, the natural differences between men become more and more marked, as does also the material expression of these differences. One individual—say a Lister—is worth to the community many millions of pounds; another is worth little or nothing, or in some cases his value may be expressed by a negative quantity. Along with this increase of inequality there comes, unhappily, the deteriorating nervous balance which accentuates discontent and social friction. The biological outlook I believe to furnish a most potent aid towards the smoothing away of such social difficulties and the lubrication of the social mechanism, for it enables us to see with clear vision through the obscuring veil of superficiality that separates class from class, and shows us how our fellow-citizens beyond, in spite of their differences in manners and clothes and language, are after all, on the average, merely human beings like ourselves, fitted out with the same strengths and trammelled by the same weaknesses as our own.

Domestic Refrigeration.

THE origin of the discovery of refrigeration as a method of food preservation is lost in the mists of antiquity. The earliest record we have of the use of cold is that the Emperor Nero employed slaves to bring snow down from the mountains to cool his wines, so it is evident that the Romans appreciated the value of refrigeration as a means of enhancing the amenities of life in hot climates. Many centuries later the story is told by Sir Walter Scott that Saladin, leader of the Mohammedan armies, sent a frozen sherbet to Richard the Lion Hearted, much to the amazement of that doughty monarch. One hopes that such a good story is not legendary.

In the thirteenth century, Marco Polo is said to have brought back to Europe recipes for water and milk ices. It is not, however, until the sixteenth century that we obtain definite evidence of refrigeration being tried as a method for arresting the chemical processes which take place in animal tissue after death. The classic experiment of Francis Bacon is worthy of note. He stuffed snow into a chicken to see if the chicken would keep fresh. This experiment had tragic consequences for Bacon; for it is related that he caught his death of cold by alighting from his carriage one winter day to try the process.

From this simple experiment a gigantic industry has arisen, and, to illustrate the magnitude of the refrigeration industry at the present day, it may be remarked that Great Britain in 1924 imported chilled and frozen meat to the value of forty-seven million pounds sterling. In spite of this rapid commercial development, progress on the purely biological side has been slow, for very little is known as to the nature of the changes which take place in flesh chilled or frozen in the course of long periods of time.

We have evidence that flesh preserved by cold from prehistoric times is at least edible, for exploration has brought to light some remarkably well preserved specimens of the mammoth. One of these found at Beresorka, Siberia, was in such a state of preservation that the frozen meat was eaten by animals and men without any ill effects. It is supposed that the creature slipped into a crevasse in a glacier which may have been covered by vegetation as in the Malapina Glacier of Alaska. It is evident that the unfortunate creature met with a violent death. The hip bone and one foreleg were broken and there was grass between the teeth and even upon the tongue.

At the present time all we can definitely say is that refrigeration as a method of food preservation is the one which causes the minimum of alteration of the desirable food properties and consequently it is to be recommended in preference to the use of preservatives.

Whilst the commercial side of the cold storage industry is well developed, and stores of enormous capacity are available, little progress has been made in Great Britain in applying refrigeration for household purposes. In the United States the domestic refrigerating plant has been pushed vigorously during the past few years. It is stated that the production of household machines in the States has increased about 100 per cent. each year for many years, and that the total now amounts to something in the neighbourhood of 100,000.

Fascinating though the subject of the domestic refrigerating plant may be from an engineering point of view, when regarded from the purely utilitarian aspect, one must recognise that great practical difficulties are involved in the introduction of the mechanical refrigerator into the household. In the first place, as British climate is not one that calls for refrigeration for any lengthy periods in the year, the machine would need to be designed so as to be ready to operate after prolonged disuse. Furthermore, it should be proof against the attentions of the too enthusiastic owner and be unaffected by neglect whilst in the care of the cook.

The 'service' required for the maintenance of a group of plants may prove to be the most serious obstacle to the successful commercial development of the domestic machine. So, whilst there can be no doubt as to the benefit of refrigeration in the home, the means of attaining it needs careful consideration. A regular and cheap supply of ice, or a cold brine supply, from one large refrigerating plant adequate to the needs of a block of buildings, may be formidable rivals to the small mechanical plant of the future.

In the present article it is proposed to give a brief sketch of two of the many refrigerating plants now on the market. The designers of such plants have approached the problem with great originality of outlook, and consequently the resulting machines bear little resemblance to the large industrial installations.

In the choice of refrigerating fluid we also find great diversity; for example, ammonia, sulphur dioxide, ethyl chloride, methyl chloride, and a mixture of ethyl chloride and methyl bromide. The properties of ammonia are so well known as to need no description. Sulphur dioxide is greatly favoured for small plants, because the working pressures are lower than is the case with ammonia machines. It is also unique among refrigerants in so much that in the liquid state it has the properties of a lubricant. The serious drawback of sulphur dioxide is its affinity for water.

The high boiling point of ethyl chloride well adapts it for use in hot climates. A disadvantage is the necessity for using as lubricant glycerine, which is hygroscopic.

Methyl chloride is a gas condensing to liquid at $-23 \cdot 7^{\circ}$ C. The admixture of methyl bromide with ethyl chloride renders the mixture non-inflammable.

The primary requirement in the case of the small plant is reliability. Certain manufacturers have produced compressor type machines which are designed so that they cannot receive any adjustment in the hands of the user beyond the turning on and off of a water tap and switch, whilst others have based their designs on the assumption that, if motive power is entirely eliminated, skilled attention becomes unnecessary. It is two of the latter type, known as absorption machines, that are described in the present article; reference may be made to the *Journal of Scientific Instruments* (August 1925) and the *Proceedings of the British Cold Storage and Ice Association*, 1925, for a description of the former class.

The absorption type of refrigerating plant is very simple in principle: ammonia gas is driven off by heat from a solution of ammonia and water; the ammonia

is condensed and the liquid ammonia then allowed to boil in an evaporator, thereby producing 'cold'; the gas is absorbed in the dilute water ammonia solution, which is now cooled by water circulation. The cycle is repeated periodically.

Many attempts have been made to render the absorption machine automatic in action, and some remarkably ingenious machines have been produced. In one, known as the Keith, the boiler and evaporator are connected by steel pipes and the whole arrangement is mounted on a pivot point so as to allow it to rock. Starting from the condition when the evaporator contains a charge of ammonia and is ready to produce 'cold' by evaporation, the following is the cycle of operations:

A stud projecting from the evaporator cools and freezes water surrounding it in a small cup attached to the wall of the cool chamber. This holds the evaporator in position until all the liquid ammonia has boiled away and is absorbed by the water in the boiler now maintained cool by water circulation. When the temperature rises the ice lock is released by the melting of the boundary of the ice in the cup and, as the boiler is several pounds heavier than the evaporator, the whole unit tilts on the pivots.

This motion switches on the electric heating to the boiler and the water on to the condenser. The ammonia vapour from the boiler is condensed in this cooler and arrives as a liquid in the evaporator. After a period of about three-quarters of an hour, the charge of ammonia has been distilled over from the boiler and condensed in the evaporator. The weight of the evaporator overbalances the boiler and the machine rocks over to the position ready for a new cycle of cooling. The operation of switching over cuts off the electric supply and switches over the water so that it circulates through a coil of pipe in the boiler.

The machine has several novel features; one is a mercury seal which is so arranged that the ammonia vapour from the evaporator is passed beneath the surface of the water in the boiler during the refrigerating part of the cycle so as to produce rapid absorption.

Another feature of the machine worthy of note is the arrangement for manufacturing a supply of small blocks of ice which can be used for cooling beverages, etc. Copper studs project from the evaporator, and project at an angle of 45° into cups. When the evaporation is complete, the ice blocks thaw slightly around the sides and are freed from the cups, permitting the machine to rock. The blocks are carried up on the studs because they are at an angle and ultimately slide off into a hopper which delivers them to an ice container located on the top shelf of the refrigerator. All the cups are automatically filled with water.

Many other attempts to render the absorption machine automatic in action have been made. Recently the problem of rendering the absorption plant both automatic and continuous in operation has been studied by two Swedish inventors, Messrs. Platen and Munters. Their machine overcomes the practical difficulties encountered by Geppert, who attempted to solve the same problem in 1899, by introducing an inert gas into the system.

A diagram of the Platen-Munters machine is given in Fig. 1. The action is as follows:—When the generator (1) is heated by a heating coil projecting into the re-entrant tube (6) the ammonia dissolved in the water evaporates, rises and enters the condenser (4), where it is liquefied. Any admixture of water vapour is condensed and separated from the ammonia in a rectifier (9) and flows back into the generator. The liquefied ammonia flows down through the condenser into the upper part of the evaporator (3), where it is met by hydrogen, which is continuously transmitted from the absorber (2) through a pipe inlet (12). The liquefied ammonia thereupon flows over a number of discs (14), placed inside the evaporator, where it evaporates in, and diffuses into, the hydrogen. This evaporation and mixing goes on until the ammonia vapour has reached the partial pressure in the mixture of gases, which corresponds to the existing conditions of temperature

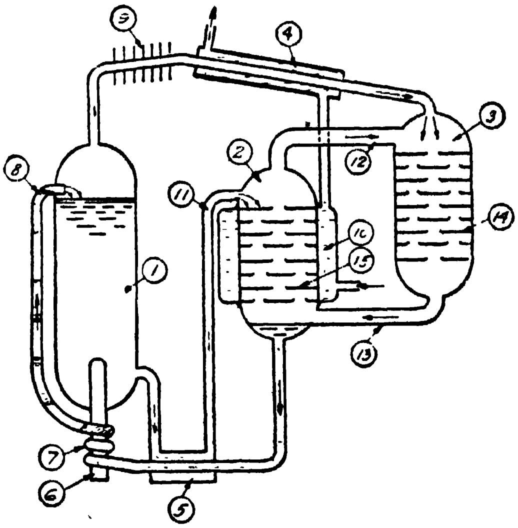

FIG. 1.—Diagram of cooling unit. 1. Generator; 2. absorber; 3. evaporator; 4. condenser; 5. heat exchanger; 6. heating medium; 7. thermo-siphon; 8. strong liquid inlet; 9. rectifier; 10. cooling jacket; 11. weak liquid inlet; 12. hydrogen inlet; 13. mixed gas outlet; 14. discs in evaporator; 15. discs in absorber. (By courtesy of Electrolux Ltd.)

and pressure in the evaporator. As the ammonia thus diffuses into the hydrogen, its partial pressure falls, but the total pressure in the evaporator remains the same as in all other parts of the apparatus. The gas mixture, consisting partly of hydrogen and partly of ammonia, is of a higher specific gravity than pure hydrogen, and therefore sinks down through the evaporator.

During the passage through the evaporator the heat-absorbing evaporation of the ammonia takes place, and accordingly heat is taken up from the surroundings through the walls of the evaporator.

From the bottom of the evaporator the gas mixture flows through a pipe (13) into the absorber (2), where it is met by a shower of water practically free of ammonia coming through a pipe (11), and passing over the discs (15) in the absorber. This water, which, by its gravity, has flowed from the generator to the absorber through the pipe (11), readily absorbs all the ammonia in the gas mixture. The hydrogen, thus denuded of ammonia, assumes thereafter the total pressure in the upper part of the absorber. The hydrogen, thus released, naturally rises, and thereby again finds its way into the evaporator. Consequently, the hydrogen rises in the absorber and sinks in the evaporator, where it

is again mixed with ammonia vapour, and in this way a continuous circulation of hydrogen between these two vessels is maintained. No hydrogen can remain in the generator while the apparatus is working, as it would be expelled by the ammonia vapour.

The return of the strong absorption liquid, from the bottom of the absorber to the generator, is provided for in a very simple way. The pipe (7-8) acts as an effective 'thermo-syphon,' by means of which the strong liquid is automatically transferred back into the upper part of the generator. The heat supplied not only lifts the liquid from the level in the absorber to the higher level in the generator, but also again releases the ammonia from the water to pursue its cycle.

It will be noticed that the weak solution when leaving the lower part of the generator is practically free from ammonia on account of the high temperature prevailing. The pipes (5) and (11), being placed inside another, act as a heat exchanger on the counterflow principle. By means of this, the hot weak liquid, which flows from the bottom of the generator into the absorber, is pre-cooled by the comparatively cold, strong liquid that flows from the absorber to the thermo-syphon. This solution is at the same time pre-heated before entering the generator.

A test was recently made at the National Physical Laboratory on behalf of Messrs. Electrolux Ltd. (153-155 Regent Street, W.1), of a small refrigerator based on the above principle. The plant supplied was built into an insulated cabinet. The generator and heat interchanger were insulated with cork. The evaporator was surrounded by a metal tank projecting into the cabinet. In the test, the evaporator tank was insulated with a layer of granulated cork. Into the tank was inserted a propeller and an electric immersion heater and thermometer. The plant was set running and the energy required in the immersion heater to maintain the tank and its contents at -5° C. was determined by trial. Then the heat abstracted by the plant under these conditions is the sum of the energy dissipated in the immersion heater and that conducted into the tank through the cork insulation. The tests were repeated at several values of the cooling water temperature.

The correction for the heat conducted into the tank was determined as follows :—After the temperature had been maintained at -5° C. for some time, the plant was switched off, and the rate of rise of temperature of the stirred liquid in the tank was observed for a considerable period. By extrapolation back of the rate of rise at various temperatures, the value of -5° C. was deduced. The heat capacity of the tank and its contents was then determined by the electrical method, the temperature rise from an initial steady temperature, due to the generation of a known quantity of heat, being measured, when the plant was not working. This, together with the rate of rise of temperature at -5° C., gives data for the rate of leakage of heat at that temperature.

The table below summarises the results.

TANK AT -5° C.

Electrical input in heating coil, 300 watts.

Inlet temperature of cooling water. (° C.)	Air temperature. (° C.)	Heat dissipated in tank around evaporator. (Kilo. cal per hr.)	Heat leakage into tank. (Kilo. cal. per hr.)	Total refrigeration effect. (Kilo cal. per hr.)
7.35	8.6	58.1	39.6	97.7
11.95	8.75	47.5	40.9	88.4
17.4	8.8	37.1	41.4	78.5

Hence it will be observed that at a cooling water temperature of 17·4° C., a total refrigeration effect of 78·5 kilo. cal. per hour is obtained for an expenditure of 258 kilo. cal. per hour in the form of electrical energy.

An ideal heat engine working between the same temperature limits and supplied with the equivalent amount of energy would give a refrigeration effect of 3090 kilo. cal. per hour.

Whether this simple ingenious machine will solve the problem of the domestic refrigerator time alone can tell. It must be realised that it is essentially an absorption type machine and, in spite of sixty years of development, this type of machine has failed to hold its own against the compressor type in the larger sized units, except where waste steam is available. An annoying trait in the older machines was the tendency for water vapour to be carried over and accumulate as ice in the evaporator.

Science in Antiquity.[1]

By Dr. J. NEWTON FRIEND.

MAN is a curious creature, at once apprehensive and superstitious. His early observations were so closely interwoven with imagination that from his records it is oft-times difficult to sift out the wheat from the chaff.

It is to Egypt that one naturally turns for the early history of science. Learning was concentrated in the temples and in the royal courts. Magicians and necromancers were intimately associated with the ruling spirits. This is well illustrated by a story in the Westcar Papyrus, concerning Seneferu, the first king of importance in the Fourth Dynasty, *circa* 3100 B.C., and the immediate predecessor of Khufu or Cheops, the builder of the Great Pyramid. It appears that upon one occasion the king was sad, and refused to be comforted by his nobles. So the magician Tchatcha-em-ankh was sent for, who advised the king to indulge in a row on the lake with a bevy of beautiful virgins. Whilst basking in the sunshine one of the maidens accidentally dropped a turquoise ornament into the water. The king, becoming acquainted with the loss, called the magician and asked him to recover

[1] Substance of a lecture delivered by the author at the Royal Institution on June 10.

the precious thing; whereupon Tchatcha-em-ankh spoke words of power, the waters of the lake heaped themselves up on one another, and the dry bed of the lake appeared with the ornament resting in the middle. This was recovered, and Tchatcha-em-ankh again spoke words of power, the waters fell back, and all was again as before. That Moses should be credited with having performed a similar miracle by making a pathway through the sea when leading the Hebrews out of Egypt need occasion no surprise. The power of a deity was measured by that of his priests, and, in the opinion of the Hebrews, Moses was no whit inferior to the followers of Amen or of Ra.

It is worthy of note that although commerce and religion demanded the use of balances in very early days, it was only about a hundred and fifty years ago that the value of the balance was generally recognised as a necessary adjunct to the systematic study of chemistry. In the Egyptian "Book of the Dead" the heart of the deceased is figured as being weighed in the Judgment Hall of Osiris, the counter-weight being truth, as typified by the ostrich feather. The balance bears an indicator, the movement of which, observed by Anubis, the Jackal-headed god of the Tomb or of embalmment, is recorded by Thoth, the Ibis-headed god, inventor of writing and science.

A similar idea of weighing good and evil runs through the Old Testament; as witness Belshazzar, who, we are told, was weighed in the balances and found wanting. It was regarded as grossly impious to use unjust weights and balances. In Hebrews ix. 4 we learn that the Ark contained Aaron's Rod, a Golden Pot, and two stones engraved with the Ten Commandments. Petrie very aptly suggests that these may have constituted the recognised Hebrew standards of length, volume, and weight respectively, which would naturally be kept under priestly control. In the Koran, written *circa* A.D. 600, the writer is evidently familiar with the conception of accurate weighing. Thus in Sura xxi. we read that "Just balances will be set up for the day of the resurrection, neither shall any soul be wronged in aught; though were a work but *the weight of a grain of mustard seed*, we would bring it forth to be weighed." About this time the Arabs appear to have had excellent balances, and some of their glass coin weights, dating back to the eighth century, have been tested in recent years and found to be remarkably accurate. Thus, three weights corresponded to 32·662, 32·665, and 32·667 grains respectively, a truly wonderful agreement (see NATURE, 1925, **115**, 963).

In A.D. 1121 an Arab, Al-Khazini by name, discussed the balance in a work entitled the "Book of the Balance of Wisdom," and gave the density of lead as 11·33. Modern values range from 11·33 to 11·35. Further, it is interesting to note that Al Jildaki, who died about A.D. 1360, stated that "substances do not react except by definite weights." A short step further and Dalton's law would have been discovered and a bridge erected over a gulf of some four hundred and fifty years.

The ancient Druids of Cæsar's time were an intelligent set of men whose schools appear to have been famous amongst the Gauls. So great was their renown that young men came over to Britain from the continent to receive instruction at first hand from them. England was the Charlottenburg of western Europe. We have too often been led to despise the Druid, who is supposed to have burned his victims wholesale in wicker cages. Even if he did, he was but in keeping with the spirit of the times. Such a death would be less lingering than crucifixion, as practised by the Romans; and certainly no more painful than the cruel Assyrian practice of flaying alive, as illustrated on their monuments.

For many reasons we may be proud of the Druids. Amongst other things they studied astronomy. To this end clocks were necessary. In the East, sun-dials were used by day and the stars by night, to tell the time; but in a climate such as that of Britain, clocks independent of the weather were a necessity. The Egyptians had two types of water-clock, but both were based on the principle that water falling into a vessel at a constant rate will uniformly raise a float, the upward movement of which is directly proportional to the time. British water-clocks, as recently shown by R. A. Smith of the British Museum, differed entirely in principle from the above, and were probably a British invention. The clock consisted of a small bronze bowl through the bottom of which a small hole was made, as in a modern flower-pot. This vessel was then floated on water in a large bronze bowl, the water slowly entering through the hole, and eventually causing it to sink. The clock appears to have been attended constantly by a slave, who would perhaps call out or strike a gong every time the vessel sank, thereby recording the time, much in the same way as the watchmen many centuries later called out the hours of the night. Vessels of bronze, somewhat resembling frying-pans, have been found in association with the bowls, and these are believed to have served as gongs for the purpose mentioned.

Alchemy may be viewed as a link between ancient and modern science. It was regarded as a divine gift, but this is not surprising when it is remembered that knowledge was mostly vested in the monasteries, and thus intimately connected with devotion. Early recipes frequently postulate that a decoction shall be heated up or otherwise treated during the recitation of a certain number of paternosters. This, of course, was to ensure that proper time was allowed for the necessary reactions to take place, and incidentally throws an interesting light on the monkish conception of time. From this it was but a short step for the superstitious to believe, or for the quack to declare, if an experiment failed, that the cause lay in lack of devotion rather than in ordinary material experimental error.

Assisting this confusion of ideas there was also a curious mystic effect due to the contact of East with West. The Eastern mind is wildly imaginative, revelling in figures of speech and parables. The more matter-of-fact Westerner, on coming into contact with Eastern science, derived, it is true, much information that was valuable, but also accepted at its face value much that was purely mystical. It was not until the time of Boyle that he was able to shake himself free from its fetters, to study Nature from a less prejudiced point of view, and thus to enter into the realm of modern science.

The British Association at Oxford.

THE history, traditions, and amenities of Oxford mark it out as a place well suited to be the scene of the annual gathering of a body like the British Association; and it may safely be pronounced that the meeting that has just come to an end is not the least successful of those that have taken place since the Association has outgrown the questionings and misgivings that accompanied its earliest activities, and has made good its claim to efficiency and usefulness in the cause of commending the results of scientific research to the consideration of the community at large. This end has been met by the more technical and specialised communications that have formed the principal business of the sections, combined with the evening discourses delivered by men eminent in their own departments of science, with public lectures in Oxford and in neighbouring towns, and with lectures specially arranged for the benefit of older scholars from the elementary schools in the city.

The fulfilment of these various purposes has been the object of much careful deliberation and contrivance during the past year, and it is the hope of those concerned in the necessary preparations that their efforts to make the present occasion a notable one have been crowned with some measure of success. Great expectations were raised by the announcement that His Royal Highness the Prince of Wales had consented to occupy the presidential chair; and it may be said at once that those expectations were amply realised. His inaugural address provided fresh evidence, if such were needed, of the interest taken in scientific progress by the highest personages in the land, and of their sense of the important bearing of a knowledge of the facts of Nature upon the welfare of the whole body of humanity. The address, admirable alike in matter and in manner, is certain, from the interesting character of its substance and the wideness of its appeal, to be of immense service in encouraging a healthy appreciation of the aims and methods of science. Nor did the good offices of the president in the same cause end with the delivery of his address. By the readiness with which he entered into the social developments of the occasion, by his accessibility, and the gracious cordiality which he showed towards all with whom he came in contact, he has done very much to promote that kindly intercourse and encourage that fellow-feeling which should affect all those who are engaged in the common task of investigating and interpreting the phenomena of Nature.

It is the opinion of many who are well qualified to judge, that the social side of these meetings, though at first sight it may seem to bear merely the appearance of a concession to the demand for amusement, has its own peculiar value in aiding that personal interchange of views and comparison of experience for which the more formal atmosphere of a scientific sitting gives often too scanty an opportunity. It is a great point gained when one scientific worker gets to know another personally. At a reception, a garden party, or on a country excursion, it very often happens that misunderstandings are removed, that causes of irritation die down, that difficulties arising from difference of temperament are smoothed over. These surely are objects worth taking some trouble to attain; nor should it be forgotten that the coming together on terms not only of scientific but also of personal sympathy may act upon the younger worker as an inspiration, and on the elder as a quickening of his interest in the new points of view that appeal to the rising generation. These ends have been well served by the Oxford meeting.

The story of St. Frideswide may be accepted as legend with some foundation in fact; and there is no reason to doubt that the schools established in connexion with her priory, the origin of which dated from the eighth century, formed the germ of the present University. Authentic history of the city begins with the raising of the castle mound by Ethelfleda, the "Lady of the Mercians," and her surrender of Oxford to her brother Edward the Elder (A.D. 912). By the end of the twelfth century Oxford was a well-known seat of learning, and before the end of the thirteenth, the noble foundation of Walter de Merton, the model of all later collegiate establishments, had started on its way. With an academic and civic history reaching back for more than a thousand years, it is perhaps strange that Oxford should have no building capable of containing more than a very moderate-sized assembly; especially when it is remembered that among the many events of historic importance that have taken place within its walls was the session of the King's parliament of 1644; this, however, was not a numerous body. But the deficiency in question was felt as a somewhat serious inconvenience when it came to be necessary to find accommodation for all those members of the Association who wished to hear the president's inaugural address, and also for those who purposed attending at the official academic and civic receptions.

The peculiarities of an ancient University, much of the life of which is embodied in colleges—all bodies with an individual constitution, in each case largely independent of that of the University—made a certain want of concentration inevitable in the space and other facilities allotted to the purposes of the meeting. A partial remedy for this inconvenience was found in the organisation of a special system of transport, by which it was possible to reach the outlying spots in the occupation of the Association without great loss of time.

It may, on the whole, be said that these and other difficulties inherent in the situation were successfully dealt with, and that the Oxford meeting of 1926 will take its place in the records of the British Association as having contributed in a remarkable degree to the maintenance and advancement of the objects of that body. A standard has been set in this and other recent annual meetings which Leeds, the seat of the next annual gathering on August 31-September 7, 1927, may be confidently expected to follow. The meeting in 1928 will be held at Glasgow.

F. A. D.

News and Views.

At all points where popular and professional opinion has ground for complaint against the present lunacy administration, the recently issued report of the Royal Commission on Lunacy affords clear and wise guidance to Parliament. The recommendations cover a wide field—public, private, and medical—and are fairly free from pettifogging and meaningless phrases. A certain vagueness appears over at least one of the more radical suggestions, namely, that concerning the end to which reorganisation of the Board of Control should be directed. But generally the advice offered is detailed and practical, or limited to the mere intimation that in particular directions improvement is desirable. The importance of provision for early treatment and for treatment without certification is generously recognised, the Commission advocating a recasting of the lunacy code "so that treatment of mental disorder should approximate as nearly to the treatment of physical ailments as is consistent with the special safeguards which are indispensable when the liberty of the subject is infringed." To this end detailed proposals are framed. The need for improving the status of asylum medical officers is expressed in terms equally explicit; so is the necessity for protecting medical practitioners, who at present undertake the duty of certification with increasing reluctance. The cost and responsibility of maintenance should, in the opinion of the Commission, be transferred from the Poor Law to the County authorities. No support is given to propagandist allegations of abuses in the administration of the Lunacy Act. On the question of the abolition or reorganisation of licensed houses, the Commission is divided. An Exchequer grant is proposed to meet the additional expenditure involved in a lunacy service such as the report envisages, and the hint is thrown out that an increase in recoveries following early care and the discovery, by research, of new possibilities of cure, will render such expenditure not wholly unremunerative. Further the Commission does not go, and it remains for its successor to present the problem of national fitness in its broader aspects as one of the major political problems of the modern State.

It is a significant fact that one of the principal founders of the British Association over which the Prince of Wales is now presiding should have belonged to his own college in Oxford, and should have preceded him at that college by almost exactly one hundred years. Dr. Charles Daubeny was up at Magdalen as a Demy from 1810 until 1814, exactly a hundred years before his successor in the presidential chair this year. This is not the time to discant upon the many-sidedness of Dr. Daubeny's work within the University. In the words of his biographer: "In his whole career Dr. Daubeny was full of that practical public spirit which delights in co-operation, and feeds upon the hope of benefiting humanity by associations of men. When the British Association came into being at York in 1831, Daubeny alone stood for the universities of England, and so standing, boldly invited that body to visit Oxford in 1832. In 1856 he became president of the Association at Cheltenham, in his native county, amidst numerous friends, who caused a medal to be struck in his honour, the only occurrence of this kind in the annals of the Association." During the recent meeting a memorial wreath was placed upon the grave of the illustrious predecessor of the present president of the Association immediately within the entrance to Magdalen College, where a simple stone inscribed "C.G.B.D." marks the place in accordance with his own wish "that he might not be separated in death from a Society with which he had been connected for the greater part of his life."

Herr Rasmussen, the Danish Minister of Defence, who is shortly paying an official visit to Denmark's colony, the Faroe Islands and her sister State, the republican kingdom of Iceland, intends thereafter to proceed to the lonely, uninhabited island of Jan Mayen, lying between Greenland, Iceland and Norway. The announced object of the Minister's visit is to arrange for the erection there of a Danish seismographic station. The Danish Government owns the buildings on the island, which were given to them, it is said, by the Austrians, who once occupied Jan Mayen. It was made the station of the Austrian polar expedition of 1882–83, but has apparently remained unclaimed ever since, though Great Britain and Norway together established a 'close season' for the seal fisheries. The whale and seal fisheries off the east and north coasts are very important during the summer. Jan Mayen land, which was discovered in 1611, by the Dutch navigator of that name, is of volcanic origin, is some 35 miles long, and practically covered with immense glaciers and, in winter, frozen waterfalls. Its highest point, an extinct volcano, is 8350 feet high. Lord Dufferin refers to the island in his book, "Letters from High Altitudes," published in 1857.

The first attempt in Great Britain to utilise the aeroplane for spraying operations in connexion with agriculture is recorded in the *Times* of August 4. Mr. George Caudwell, of Weston, near Spalding, Lincolnshire, chartered a private aeroplane piloted by Major Savage, and 40 acres of Majestic potatoes were sprayed in 25 minutes, in contrast to the two days which would have been occupied for the same operation by ordinary methods. The machine flew so low that at times it almost touched the potato tops, and the spray, in the form of a fine powder, was blown on to the leaves of the plants through two pipes on either side of the fuselage. Although this method of spraying is new to Britain, it has been applied on a large scale in the United States for the control of insect pests, extensive areas of cotton being treated in this way with considerable success. Experiments are being carried on with the view of extending the scope of application of the method to deal with a larger range of plant pests. So far as Great Britain is concerned, the report of the success of

Mr. Caudwell's initial experiment will be awaited with great interest. It would seem, however, that practical difficulties may limit the application of aerial spraying in those parts of the country which are subdivided into relatively small fields with dividing hedges, but where large open areas are available much time and labour would be economised if success is attained.

AT the recent graduation ceremonial of the University of Edinburgh an interesting address to the new graduates was delivered by Prof. J. H. Ashworth. In tracing the historical development of the Edinburgh School of Zoology, Prof. Ashworth emphasised the debt it owes to three of its professors of anatomy—Monro, Monro *secundus*, and Goodsir. The first two of these were responsible for discoveries of fundamental importance to morphological science. It was Monro who demonstrated the absence of free interchange of blood between the fœtal and the maternal parts of the placenta: it was Monro *secundus* who anticipated by eighty years the discovery by Kühne of the motor nerve-endings in muscle. The same observer, whose name is permanently registered in anatomical text-books by the 'foramen of Monro,' was also the author of the great monograph "On the structure and physiology of fishes, explained and compared with those of man and other animals." Having traced the past history of his subject, Prof. Ashworth alluded to the generous contribution of 20,000*l*. by Dr. Laurence Pullar, which, with an allocation of 18,000*l*. by the Carnegie Trust, made it at last possible to contemplate the housing of the University Department of Zoology in a building fully adequate for the special needs of zoological teaching and research. The latter part of the address was devoted to emphasising the importance of the contribution which the subject of zoology is now making to the training and outlook of the medical man on one hand, and to the general progress of mankind on the other. Zoology has established itself as an integral part in the scientific foundation of preventive medicine: it is playing a part in the advancement of civilisation and in the amelioration of the conditions of life in various parts of the world to an extent that would have been inconceivable a generation ago.

A MONUMENT to the memory of John Ericsson, the famous Swedish-American engineer, was recently unveiled at Washington, D.C., by the Crown Princess Louise of Sweden. The ceremony was under the auspices of the American Society of Swedish Engineers. Erected not far from the memorial to Lincoln, the monument consists of a group symbolic of vision, adventure, and labour, standing on a massive granite pedestal, in the front of which is a statue of Ericsson, who is depicted sitting in contemplative mood. President Coolidge, responding to the speech of the Swedish Crown Prince, remarked: "Great men are the product of a great people. They are the result of many generations of effort, toil, and discipline. They are the incarnation of the spirit of the people." An unusually precocious boy, Ericsson was born in 1803 at Filipstad, Sweden, and when quite young was employed on drawings and levelling in connexion with the Göta Canal. He resided in England from 1826 until 1839, while the rest of his life was spent in the United States. His locomotive *Novelty* competed with Stephenson's *Rocket* in 1829; he was one of the chief promoters of screw propulsion, and a pioneer in the use of hot-air engines. He is best known, however, for his design and construction of the *Monitor* turret vessel.

THE annual report of the Zoological Society of Scotland for the year ending in March last is a record of the most sucessful year in the history of the Society. The large increases in the number of visitors to the Zoological Park at Edinburgh, and in the number of new fellows admitted, witness to the growing popularity and interest in its work. During the year the new Tropical Bird House and the new Reptile House were completed, and a start has been made on the Carnegie Aquarium. The latter is being built with the aid of a grant from the Carnegie Trustees, and it is hoped to have it ready for opening at the end of the year. It will add enormously to the attractions of the gardens. In spite of the rigours of the northern winter, the stock in the gardens appears to flourish and breed in quite a satisfactory manner. The number of deaths is below the average, and a good proportion of the young animals born during the year was successfully reared. One of the most notable of the deaths was that of one of the original King penguins, which proved unable to survive the strain of incubating and rearing its last chick. The financial statement reveals a healthy condition of things, and a substantial surplus from last year's activities is to be devoted to capital purposes.

A SECOND report has been issued by the Medical Research Council on the gold treatment of tuberculosis. The drug employed was sanocrysin and the report deals almost entirely with clinical experience, based on about 140 cases treated. As a result of previous experience the dangers attending the use of the drug have been greatly lessened. There is necessarily a conflict of opinion, some clinicians believing that little benefit results from the treatment. Others, however, are very emphatic in the opinion that sanocrysin did cause unusually rapid amelioration of symptoms, particularly in the lessening of sputum and disappearance of tubercle bacilli in pulmonary tuberculosis.

THE success of the Department of the Interior of Canada in its efforts to save the buffalo from extinction is shown in the fact that the great park at Wainwright, Alberta, is unable to support a further increase in the herd at present there. This park is approximately 15 miles long and 13 miles wide, and was thought by many, even a few years ago, to be ample for all time. Provision will now have to be made for the disposal of the annual increase in the herd, and the action taken by the Department will be watched with interest.

In connexion with the recent meeting of the British Association at Oxford, the honorary degree of D.Sc. (Oxon.) was conferred upon the following distinguished visitors: Prof. Niels Bohr, professor of physics in the University of Copenhagen; The Abbé Breuil, professor of the Institute of Human Palæontology, Paris; Sir Frank W. Dyson, Astronomer Royal; Prof. A. S. Eddington, Plumian professor of astronomy in the University of Cambridge; Sir Daniel Hall, Chief Scientific Adviser to the Ministry of Agriculture; Prof. Henry Fairfield Osborn, research professor of zoology in Columbia University; Sir Edward A. Sharpey-Schafer, professor of physiology in the University of Edinburgh; Mr. F. E. Smith, Director of Scientific Research, Admiralty; Sir Josiah Stamp; Prof. Vito Volterra, professor of mathematics in the University of Rome and president of the Royal National Academy of the Lincei; Prof. Wilhelm Wien, professor of experimental physics in the University of Munich.

The Earl of Midleton will open the new buildings of the Haslemere Educational Museum, Haslemere, Surrey, on August 27 next. A memorial tablet to Sir Jonathan Hutchinson is to be unveiled by Dr. F. A. Bather on the same occasion.

Prof. Jocelyn F. Thorpe, professor of organic chemistry in the Imperial College of Science and Technology, South Kensington, has been appointed chairman of the Explosives in Mines Research Committee, in succession to Sir Frederic L. Nathan, who has resigned. Mr. F. E. Smith, Director of Scientific Research under the Admiralty, has been made an additional member of the Committee.

An autumn meeting of the Institute of Metals is to be held at Liége on September 1-4. A number of papers on the constitution and properties of non-ferrous metals and alloys will be read and discussed, and visits to works and to places of interest in the neighbourhood have been arranged. Particulars can be obtained from the secretary of the Institute at 36 Victoria Street, London, S.W.1.

The trustees of the British Museum have revived the office of secretary, which since 1851 has been combined with that of principal librarian. In future the secretary will act as assistant to the director and principal librarian, with the status of a keeper. Mr. Arundell Esdaile, hitherto assistant keeper in the Department of Printed Books, has been appointed secretary.

The Duke of York will visit the Harper Adams Agricultural College, Newport, Shropshire, on Wednesday, November 3, for the formal opening of the National Institute of Poultry Husbandry, established at the College under the joint auspices of the Ministry of Agriculture and the National Poultry Council. This signal recognition of the importance of the recent advances in the provision of adequate facilities for advanced education and experimental work in poultry husbandry will be warmly appreciated by all engaged in the industry.

An Order of Council has been issued altering the composition of the Committee of Privy Council for Medical Research, the ministerial body under which the Medical Research Council conducts its work. The Committee originally consisted of the Lord President of the Council, the Minister of Health (England and Wales), the Secretary for Scotland, and the Chief Secretary for Ireland, but the last-named office has become obsolete as a result of the changes in the government of Ireland. In view of this vacancy, and of the increasing relation of the Medical Research Council to research work in overseas parts of the Empire and in industrial medicine, the Secretaries of State for Home Affairs, for Dominion Affairs and for the Colonies have now been added to the Committee.

Dr. A. W. Hill, Director of the Royal Botanic Gardens, Kew, sailed on Saturday last for the United States, where he is attending the International Congress of Plant Sciences (the fourth International Botanical Congress) at Ithaca, N.Y., on August 16-23, as one of the official delegates of Great Britain. Dr. E. J. Butler (Imperial Bureau of Mycology), Dr. A. B. Rendle and Mr. J. Ramsbottom (British Museum (Natural History)) and Mr. Sprague (Kew) are also attending the Congress in an official capacity. After the Congress, Dr. Hill is going on to the Missouri Botanical Garden and the University of California, Berkeley, where he is to deliver three lectures, and returning via Vancouver, Toronto, Washington, D.C., and finally New York, where another lecture will be given in the Botanical Garden.

The centenary year of Lord Lister's birth will be celebrated in Edinburgh in July 1927 during the meeting of the British Medical Association. The Committee responsible for the celebration is anxious to interest students and young graduates in the significance of Lister's work, and is offering a prize of a gold medal and 25*l.* for the best essay upon the subject, "The Influence of Lister on the Evolution of Surgery." The prize is open to registered students and graduates of not more than one year's standing of any medical school of the British Empire. Essays must be submitted by May 1, 1927, to Prof. J. Fraser, Convener of the Lister Memorial Committee, 32 Moray Place, Edinburgh. The award of the prize will be made at the Lister Celebration meeting, July 1927.

The report of the sixth International Congress of Photography has been published by the Société Française de Photographie, 51 rue de Clichy, Paris (9^e^). It contains an account of the proceedings at each meeting, and the papers and reports that were presented to the Congress, but the final resolutions as to standard methods of sensitometry, and procedure in other matters in which uniformity is desirable, will be issued later. The subjects treated of at the Congress are classified under the following heads: Sensitometry, optics, photochemistry, history and documentary, and kinematography; in each case the

practical applications are dealt with as well as the fundamental theories. The membership of the Congress numbered about 240, and was well representative of all the centres of scientific photographic activity.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A chemist and metallurgist in the Government Assay Office in Cairo—A. G. Innes, c/o Chief Inspecting Engineer, Egyptian Government, 41 Tothill Street, S.W.1 (August 17). A lecturer in economics at the Imperial College of Tropical Agriculture, Trinidad—The Secretary of the College, 14 Trinity Square, E.C.3 (August 24). An assistant to the professor of surgery in the University of Bristol—The Registrar (August 28). An extra mural organiser at Armstrong College, Newcastle-upon-Tyne—The Registrar (August 31) Junior assistants at the National Physical Laboratory, preferably with some research or technical experience in either physics, engineering or electrical engineering—The Director, National Physical Laboratory, Teddington (September 4). An assistant lecturer in textile engineering at the Manchester Municipal College of Technology—The Registrar (September 20). An assistant secretary of the Oxford University Appointments Committee—The Secretary, 40 Broad Street, Oxford (October 1). A full-time assistant, or two part-time assistants, in the Department of History and Method of Science of University College, London—The Secretary, University College, Gower Street, W.C.1. Evening teachers in electrical engineering and mechanical engineering at the Croydon Polytechnic—The Principal, Central Polytechnic, Scarbrook Road, Croydon. Full-time teachers in the Physics and Chemistry Departments of the Northern Polytechnic—The Clerk to the Governors, Northern Polytechnic, Holloway, N.7.—A junior assistant under the directorate of Metallurgical Research, Research Department, Woolwich, for work mainly in connexion with technical records, reports and literature—The Chief Superintendent, Research Department, Woolwich, S.E.18.

Our Astronomical Column.

FINLAY'S COMET.—This periodic comet was discovered by Mr. Finlay, Chief Assistant at the Cape Observatory, in 1886, and was observed again in 1893, 1906, 1919. S. Kanda and S Hasunuma, of Tokyo Observatory, calculated from the 1919 observations the conditions of the present return, the perturbations by Jupiter in the interim having been considerable, producing an increase of about 6 weeks in the period. With the aid of their ephemeris, Dr. J. Stobbe succeeded in photographing the comet on August 3 at Bergedorf Observatory, near Hamburg. Its magnitude was 11·5, and its position at $0^h\ 40{\cdot}6^m$ U T. was R A $4^h\ 3^m\ 48^s$, N. Decl. 17° 48′. The position indicates that perihelion occurred Aug. 7·9 U T., which is 0·7 day later than the Tokyo prediction.

The following ephemeris is for 0^h U T.

		R.A.	N. Decl
Aug	15	$4^h\ 56{\cdot}3^m$	20° 33′
	19	5 12·8	21 14
	23.	5 28·6	21 47
	27.	5 43·9	22 13
	31.	5 58 8	22 32

The comet is a morning object passing near ζ Tauri on August 23, and entering Gemini on August 31. It is well placed for observation, but is growing slowly fainter, since the distance from both sun and earth is increasing.

A plate was exposed by Mr F. J Hargreaves of Kingswood, Surrey, on July 21 at $1^h\ 53{\cdot}5^m$ U T. At first the comet was not detected upon it, but with the guidance of Dr. Stobbe's position, Mr. P J Melotte found a faint impression of the comet in R.A. $3^h\ 2^m\ 30{\cdot}8^s$, N. Decl. 13° 19′ 36″ (Equinox 1926·0).

THE NEW SOLAR RADIATION STATION IN SOUTH AFRICA.—A bulletin issued by the Smithsonian Institution describes Dr. C. G. Abbot's journey of 30,000 miles in search of the most suitable station in the eastern hemisphere. The desiderata were an elevated region, dry clear air, reasonable accessibility, and absence of wild tribes. This last consideration caused the rejection of Khojak Peak, 70 miles northwest of Quetta, though the sky conditions were superb. Stations in the Sahara, Egypt, and Mt. Sinai were visited and rejected. His choice fell on Mt Brukkaros in South-West Africa, 200 miles south of Windhoek, and 20 miles from the railway. It is an isolated peak 5200 feet above the sea, and 2000 feet above the surrounding plain. The sky was found to be remarkably clear, the stars being brilliant right down to the horizon The rainfall is very small, none having fallen for ten months. There is a crater at the top with a gap to the south east, which was found to be suitable for the excavation of a tunnel for the bolometer. The sun will be observable an hour after sunrise. A neighbouring cave will be converted into a residence for the observers, Mr. W. H. Hoover and Mr. F A Greeley.

Mr. A. Dryden, Public Works Inspector, S W Africa, has undertaken the preparation of the building, and it is hoped to commence observations in September. There are prospects of daily observations for ten months in the year, and for three-quarters of the days in the remaining two months (the so-called rainy season). The Observatory is to supplement, not to replace, the stations already existing in Chile and California.

PROPER MOTIONS OF SOUTHERN STARS.—*Memoirs of the Royal Astronomical Society*, vol. 64 (part 2), contains a catalogue of proper motions in declination of 1738 southern stars by Dr. J. E. de Vos van Steenwijk. The recent observations of the stars were made by himself at La Plata They are compared with older observations made at the Cape, Parramatta, Santiago, Madras, and other southern observatories. The systematic corrections given by Boss have been applied. The magnitudes range from $5{\cdot}8^m$ to $8{\cdot}8^m$. The probable errors of annual motion are given, they are mainly in the neighbourhood of 0·006″.

The following seven large motions are believed to be new: No. 166, mag. 6·1, type F8, P.M. + 0·245″; No. 200, mag 6·4, type G0, P.M. + 0·457″; No. 470, mag. 6·9, type F8, P.M. + 0·713″; No. 631, mag. 7·4, type F8, P.M. + 0·593″; No. 1529, mag. 7·9, type B3, P.M. − 0·370″; No. 1774, mag. 7·0, type K0, P.M. 0·814″; No. 2664, mag. 7·2, type B8, P.M. − 0·490″. It is unfortunate that the motions in R.A. are not given.

Research Items.

THE PSYCHOLOGY OF AMUSEMENTS.—In the *Nineteenth Century* (July 1926) M. Willson Disher discusses the 'Psychology of the Show.' He points out the antiquity of the show or circus, a form of entertainment referred to in Homer, and its almost universal appeal. He finds that the various incidents resolve themselves into means whereby the visitor can experience novel sensations, or normal sensations in an intenser form, and so obtain a heightened thrill. Normal behaviour is overturned, people delight in seeing men, beasts, and things put to any but their ordinary uses, and they prefer to be deceived. The means employed vary with the advance of knowledge, but the experiences aimed at remain the same. The power moving the roundabout may change, but the general appearance has changed but little. Men on holiday bent prefer to be able to return to the attitude of childhood, and this can best be secured by similarity of outward appearance. Hence attempts to 'show up' the tricks of the show have but little effect on the show. People are seeking, not an appeal to their reason, but an appeal to their primary emotions, and are not grateful to those who would deprive the stimulus of its power. Perhaps Prof. Karl Groos' famous theory of play may be suitably recalled in this connexion After his theory of the play of children and animals, which suggests that, biologically, in play, instincts are exercised for later use, he urges that in adult play we seek (i.) 'completion of life,' *i.e.* to experience sensations and emotions which normally in our work receive little or no gratification, (ii.) freedom from the constraint of 'must.' Fear in a limited degree, which we invoke by our own will, is very different from the fear which we experience in defiance of our will. This the show can do for us: we need not go, we can depart when we like. There is, therefore, for a short space of time, granted to us the power to feel masters of ourselves.

CRANIOMETRY OF SINGAPORE COOLIES.—Dr. Gordon Harrower of Singapore has contributed to Vol. 54, Pt. 3, of the *Trans. Roy. Soc. Edinburgh* the results of an examination of the skulls of 54 male Tamils and 36 male Hokien obtained from unclaimed bodies of coolies. In cranial capacity the Hokien is on a par with the most intellectual races, and cannot be regarded as falling within the mesocephalic group in which Chinese skulls are generally classed. The Tamil, however, is on the border line of the meso- and microcephalic groups, approaching the modern negro. Yet the Hokien and Tamil skulls are approximately equal in length, the difference coming out in the breadth. In the different races compared, the Tamil is the second lowest, being only 0·9 mm. more than the Australian, while the maximum breadth of the Hokien is exceeded only by certain of the Burmese and the Ainu groups. The skull is markedly mesaticephalic. According to the view of Chinese ethnological history now generally held, the Hokien, who are natives of the Province of Fu-kien, are survivors of the aborigines who were driven into the highlands when the early invaders of northern China from eastern Turkestan had penetrated to the south of the Yangtze-kiang. The result of the present investigation strongly supports this view. The Hokien are a pure type, brachycephalic with high cranial capacity, narrow frontal region, well-marked prognathism, and distinctly sinotic megaseme orbits. The palate is primitive. In the Tamil skull the most noteworthy feature is the position of the foramen magnum, which is relatively far back. It appears to be a pure type characteristic of the Dravidian, and shows no element incompatible with the current view of the ethnological history of southern India.

DECCAN VILLAGE LIFE IN THE EIGHTEENTH CENTURY.—Interesting side-lights are thrown on the customs of the Marâṭhâs by selections from the diary of the Râja of Satâra, Sivâji II. or Shâhu, who reigned 1708–1749, which are quoted by Mr. S. M. Edwardes in the *Indian Antiquary* for June. The position of *pâṭel*, or headman of the village community, is shown to entail both responsibilities and privileges of no little importance. He took precedence in various functions, such as the presentation of the ritual cake at the *Holi*, the annual procession in honour of Gaṇesa and Gauri, at the annual *Poḷa* procession, when the *Poḷa*, a bull dedicated to the gods, was marked with a trident and discus and allowed to roam at large. He held a prior claim to the decoration of his house with festoons of flowers by the Mâng and with red-ochre by the Mahâr, and to the supply of water by the village Koḷi or hereditary village servant, who was the recognised water-carrier. One of the processions in which the headman claimed precedence was the annual Śirâḷśet procession, Śirâḷśet being a legendary corn-chandler who became king for a short time, and an earthen image of whom was worshipped, carried in procession, and then thrown into a well or tank An important rôle was filled by the headman in disputes about village boundaries. In a dispute of this nature in 1744, when other evidence failed to establish the facts, the *pâṭel* was ordered to put a cowhide over his head and shoulders and, so adorned, to walk step by step over the real boundaries of the village. He was then kept under watch for fifteen nights As nothing untoward happened to him he was declared to have indicated the boundary truthfully The underlying idea was that the *pâṭel*, having put the hide over his head and shoulders, became imbued with the divine influence of the sacred animal and must therefore speak the truth. In Mysore, in similar circumstances, an inferior village servant of the Holeya tribe had to carry on his head a ball of earth, scooped up in the village, with water in the middle, in which was the divine presence of the village goddess. If he went beyond the true boundary this ball of earth, it was believed, would fall to pieces, and he, having incurred the wrath of the goddess, would die in a fortnight and his house become a ruin

A NEW ISOPOD FROM THE CHATHAM ISLANDS.—Prof. C. Chilton (*Records Canterbury Mus.*, New Zealand, vol. 11, pp 321–326, 1925) has found among the Isopoda collected at the Chatham Islands five small specimens from a fresh-water stream, for which he establishes a new genus Paravireia in the subfamily Sphæromimæ. The body is very convex and capable of rolling into a ball, but this genus differs from all other members of the subfamily in having five separate segments in the abdomen. A detailed description is given of a male specimen. The group (Monolistrini) to which this new genus belongs is probably an ancient one that has survived owing to the adoption of a fresh-water, and, in most cases, an underground, mode of life. The author directs attention to the interest attaching to the occurrence of this new genus in the Chatham Islands and the genus Vireia in underground waters in Europe—two very nearly related forms in localities so remote from each other.

VITALISM AND MECHANISM.—The editor of *Scientia* returns in the issues of his review for April and May

practical applications are dealt with as well as the fundamental theories. The membership of the Congress numbered about 240, and was well representative of all the centres of scientific photographic activity.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A chemist and metallurgist in the Government Assay Office in Cairo—A. G. Innes, c/o Chief Inspecting Engineer, Egyptian Government, 41 Tothill Street, S.W.1 (August 17). A lecturer in economics at the Imperial College of Tropical Agriculture, Trinidad—The Secretary of the College, 14 Trinity Square, E.C.3 (August 24). An assistant to the professor of surgery in the University of Bristol—The Registrar (August 28). An extra mural organiser at Armstrong College, Newcastle-upon-Tyne—The Registrar (August 31). Junior assistants at the National Physical Laboratory, preferably with some research or technical experience in either physics, engineering or electrical engineering—The Director, National Physical Laboratory, Teddington (September 4). An assistant lecturer in textile engineering at the Manchester Municipal College of Technology—The Registrar (September 20). An assistant secretary of the Oxford University Appointments Committee—The Secretary, 40 Broad Street, Oxford (October 1). A full-time assistant, or two part-time assistants, in the Department of History and Method of Science of University College, London—The Secretary, University College, Gower Street, W.C.1. Evening teachers in electrical engineering and mechanical engineering at the Croydon Polytechnic—The Principal, Central Polytechnic, Scarbrook Road, Croydon. Full-time teachers in the Physics and Chemistry Departments of the Northern Polytechnic—The Clerk to the Governors, Northern Polytechnic, Holloway, N.7.—A junior assistant under the directorate of Metallurgical Research, Research Department, Woolwich, for work mainly in connexion with technical records, reports and literature—The Chief Superintendent, Research Department, Woolwich, S.E.18.

Our Astronomical Column.

FINLAY'S COMET.—This periodic comet was discovered by Mr. Finlay, Chief Assistant at the Cape Observatory, in 1886, and was observed again in 1893, 1906, 1919. S. Kanda and S. Hasunuma, of Tokyo Observatory, calculated from the 1919 observations the conditions of the present return, the perturbations by Jupiter in the interim having been considerable, producing an increase of about 6 weeks in the period. With the aid of their ephemeris, Dr. J. Stobbe succeeded in photographing the comet on August 3 at Bergedorf Observatory, near Hamburg. Its magnitude was 11·5, and its position at $0^h\ 40{\cdot}6^m$ U.T. was R.A. $4^h\ 3^m\ 48^s$, N. Decl. 17° 48′. The position indicates that perihelion occurred Aug. 7·0 U.T., which is 0·7 day later than the Tokyo prediction.

The following ephemeris is for 0^h U.T.

	R.A.	N. Decl.
Aug 15.	$4^h\ 56{\cdot}3^m$	20° 33′
19	5 12·8	21 14
23.	5 28·6	21 17
27.	5 43·9	22 13
31.	5 58·8	22 32

The comet is a morning object passing near ζ Tauri on August 23, and entering Gemini on August 31. It is well placed for observation, but is growing slowly fainter, since the distance from both sun and earth is increasing.

A plate was exposed by Mr. F. J. Hargreaves of Kingswood, Surrey, on July 21 at $1^h\ 53{\cdot}5^m$ U.T. At first the comet was not detected upon it, but with the guidance of Dr. Stobbe's position, Mr. P. J. Melotte found a faint impression of the comet in R.A. $3^h\ 2^m\ 30{\cdot}8^s$, N. Decl. 13° 19′ 36″ (Equinox 1926·0).

THE NEW SOLAR RADIATION STATION IN SOUTH AFRICA.—A bulletin issued by the Smithsonian Institution describes Dr. C. G. Abbot's journey of 30,000 miles in search of the most suitable station in the eastern hemisphere. The desiderata were an elevated region, dry clear air, reasonable accessibility, and absence of wild tribes. This last consideration caused the rejection of Khojak Peak, 70 miles north-west of Quetta, though the sky conditions were superb. Stations in the Sahara, Egypt, and Mt. Sinai were visited and rejected. His choice fell on Mt. Brukkaros in South-West Africa, 200 miles south of Windhoek, and 20 miles from the railway. It is an isolated peak 5200 feet above the sea, and 2000 feet above the surrounding plain. The sky was found to be remarkably clear, the stars being brilliant right down to the horizon. The rainfall is very small, none having fallen for ten months. There is a crater at the top with a gap to the south-east, which was found to be suitable for the excavation of a tunnel for the bolometer. The sun will be observable an hour after sunrise. A neighbouring cave will be converted into a residence for the observers, Mr. W. H. Hoover and Mr. F. A. Greeley.

Mr. A. Dryden, Public Works Inspector, S.W. Africa, has undertaken the preparation of the building, and it is hoped to commence observations in September. There are prospects of daily observations for ten months in the year, and for three-quarters of the days in the remaining two months (the so-called rainy season). The Observatory is to supplement, not to replace, the stations already existing in Chile and California.

PROPER MOTIONS OF SOUTHERN STARS.—*Memoirs of the Royal Astronomical Society*, vol. 64 (part 2), contains a catalogue of proper motions in declination of 1738 southern stars by Dr. J. E. de Vos van Steenwijk. The recent observations of the stars were made by himself at La Plata. They are compared with older observations made at the Cape, Parramatta, Santiago, Madras, and other southern observatories. The systematic corrections given by Boss have been applied. The magnitudes range from $5{\cdot}8^m$ to $8{\cdot}8^m$. The probable errors of annual motion are given; they are mainly in the neighbourhood of 0·006″.

The following seven large motions are believed to be new: No. 166, mag. 6·1, type F8, P.M. + 0·245″; No. 200, mag. 6·4, type G0, P.M. + 0·457″; No. 470, mag. 6·9, type F8, P.M. + 0·713″; No. 631, mag. 7·4, type F8, P.M. + 0·593″; No. 1529, mag. 7·9, type B3, P.M. − 0·370″; No. 1774, mag. 7·0, type K0, P.M. − 0·814″; No. 2664, mag. 7·2, type B8, P.M. − 0·490″. It is unfortunate that the motions in R.A. are not given.

Research Items.

THE PSYCHOLOGY OF AMUSEMENTS.—In the *Nineteenth Century* (July 1926) M. Willson Disher discusses the 'Psychology of the Show.' He points out the antiquity of the show or circus, a form of entertainment referred to in Homer, and its almost universal appeal. He finds that the various incidents resolve themselves into means whereby the visitor can experience novel sensations, or normal sensations in an intenser form, and so obtain a heightened thrill. Normal behaviour is overturned, people delight in seeing men, beasts, and things put to any but their ordinary uses, and they prefer to be deceived. The means employed vary with the advance of knowledge, but the experiences aimed at remain the same. The power moving the roundabout may change, but the general appearance has changed but little. Men on holiday bent prefer to be able to return to the attitude of childhood, and this can best be secured by similarity of outward appearance. Hence attempts to 'show up' the tricks of the show have but little effect on the show. People are seeking, not an appeal to their reason, but an appeal to their primary emotions, and are not grateful to those who would deprive the stimulus of its power. Perhaps Prof. Karl Groos' famous theory of play may be suitably recalled in this connexion After his theory of the play of children and animals, which suggests that, biologically, in play, instincts are exercised for later use, he urges that in adult play we seek (i.) 'completion of life,' *i.e.* to experience sensations and emotions which normally in our work receive little or no gratification, (ii.) freedom from the constraint of 'must.' Fear in a limited degree, which we invoke by our own will, is very different from the fear which we experience in defiance of our will. This the show can do for us: we need not go, we can depart when we like. There is, therefore, for a short space of time, granted to us the power to feel masters of ourselves.

CRANIOMETRY OF SINGAPORE COOLIES.—Dr. Gordon Harrower of Singapore has contributed to Vol. 54, Pt. 3, of the *Trans Roy. Soc. Edinburgh* the results of an examination of the skulls of 54 male Tamils and 36 male Hokien obtained from unclaimed bodies of coolies. In cranial capacity the Hokien is on a par with the most intellectual races, and cannot be regarded as falling within the mesocephalic group in which Chinese skulls are generally classed. The Tamil, however, is on the border line of the meso- and microcephalic groups, approaching the modern negro. Yet the Hokien and Tamil skulls are approximately equal in length, the difference coming out in the breadth. In the different races compared, the Tamil is the second lowest, being only 0·9 mm. more than the Australian, while the maximum breadth of the Hokien is exceeded only by certain of the Burmese and the Ainu groups. The skull is markedly mesaticephalic. According to the view of Chinese ethnological history now generally held, the Hokien, who are natives of the Province of Fu-kien, are survivors of the aborigines who were driven into the highlands when the early invaders of northern China from eastern Turkestan had penetrated to the south of the Yangtze-kiang. The result of the present investigation strongly supports this view. The Hokien are a pure type, brachycephalic with high cranial capacity, narrow frontal region, well-marked prognathism, and distinctly sinotic megaseme orbits. The palate is primitive. In the Tamil skull the most noteworthy feature is the position of the foramen magnum, which is relatively far back. It appears to be a pure type characteristic of the Dravidian, and shows no element incompatible with the current view of the ethnological history of southern India.

DECCAN VILLAGE LIFE IN THE EIGHTEENTH CENTURY.—Interesting side-lights are thrown on the customs of the Marâṭhâs by selections from the diary of the Râja of Satâra, Sivâji II. or Shâhu, who reigned 1708–1749, which are quoted by Mr. S. M. Edwardes in the *Indian Antiquary* for June. The position of *pâṭel*, or headman of the village community, is shown to entail both responsibilities and privileges of no little importance. He took precedence in various functions, such as the presentation of the ritual cake at the *Holi*, the annual procession in honour of Gaṇésa and Gauri, at the annual *Poḷa* procession, when the *Poḷa*, a bull dedicated to the gods, was marked with a trident and discus and allowed to roam at large. He held a prior claim to the decoration of his house with festoons of flowers by the Mâng and with red-ochre by the Mahâr, and to the supply of water by the village Koḷî or hereditary village servant, who was the recognised water-carrier. One of the processions in which the headman claimed precedence was the annual Śirâḷśet procession, Śirâḷśet being a legendary corn-chandler who became king for a short time, and an earthen image of whom was worshipped, carried in procession, and then thrown into a well or tank. An important rôle was filled by the headman in disputes about village boundaries In a dispute of this nature in 1744, when other evidence failed to establish the facts, the *pâṭel* was ordered to put a cowhide over his head and shoulders and, so adorned, to walk step by step over the real boundaries of the village. He was then kept under watch for fifteen nights. As nothing untoward happened to him he was declared to have indicated the boundary truthfully The underlying idea was that the *pâṭel*, having put the hide over his head and shoulders, became imbued with the divine influence of the sacred animal and must therefore speak the truth. In Mysore, in similar circumstances, an inferior village servant of the Holeya tribe had to carry on his head a ball of earth, scooped up in the village, with water in the middle, in which was the divine presence of the village goddess. If he went beyond the true boundary this ball of earth, it was believed, would fall to pieces, and he, having incurred the wrath of the goddess, would die in a fortnight and his house become a ruin.

A NEW ISOPOD FROM THE CHATHAM ISLANDS.—Prof. C. Chilton (*Records Canterbury Mus.*, New Zealand, vol. 11, pp. 321-326, 1925) has found among the Isopoda collected at the Chatham Islands five small specimens from a fresh-water stream, for which he establishes a new genus Paravireia in the subfamily Sphæromínæ. The body is very convex and capable of rolling into a ball, but this genus differs from all other members of the subfamily in having five separate segments in the abdomen. A detailed description is given of a male specimen. The group (Monolistrini) to which this new genus belongs is probably an ancient one that has survived owing to the adoption of a fresh-water, and, in most cases, an underground, mode of life. The author directs attention to the interest attaching to the occurrence of this new genus in the Chatham Islands and the genus Vireia in underground waters in Europe—two very nearly related forms in localities so remote from each other.

VITALISM AND MECHANISM.—The editor of *Scientia* returns in the issues of his review for April and May

to the consideration of vitalism and mechanism, and seeks a solution of an intermediate character. In the June issue M. Leclerc du Sablon briefly examines the principal criteria which serve to distinguish living matter, and points out that in essence they are the transformations of matter and of energy which take place in the protoplasm of living beings. He believes that it is permissible to hope that the progress of chemical knowledge, which has already elucidated so many matters which appeared to our intelligence mysterious and inaccessible, may one day reveal to us the mechanism of life. He holds that it is a purely verbal solution to attribute the activity of living matter to a vital force. Every progressive step has permitted a deeper penetration into the knowledge of the phenomena which characterise life, and it is only by the slow and empirical method—as in the case of physics and chemistry—that our ideas of living matter can become more clear and more adequate. No other way can be adopted without going outside the prescribed limits of science. He concludes that the nature and origin of life may serve as a theme for the speculation of philosophers; they are not subjects of study for biologists.

THE CONTROL OF LOBSTER FISHERIES.—The interim report recently issued of the Interdepartmental Committee appointed by the Minister of Agriculture and Fisheries and the Secretary for Scotland to inquire into the crab and lobster fisheries of Great Britain (London: H.M. Stationery Office, 1926. 2s. 6*d*. net) gives the results of the Committee's inquiry into the lobster fishery only, the crab fishery being left until further evidence, which is to be obtained, has been considered. In accordance with the terms of reference, the Committee deals at some length with the question of further protection of the lobster of both sexes by an increase in the size below which the animal may not be taken, and of the berried female by forbidding its landing and exposure for sale during the whole or parts of the year, and the opinion is expressed that a real protection of the berried lobster would materially help to maintain an adequate lobster population. At the same time, it is held that the present position of the lobster fishery and such statistics as are available do not warrant immediate legislation in this direction In a minority report Prof. A. Meek gives statistical evidence, accumulated since 1905 by the Northumberland Sea Fisheries Committee, which he regards as adequate grounds for the framing of an act to protect the berried lobster. An undersized lobster is of little commercial value, and, so far as the writer's experience goes, there is but little contravention of the law forbidding its landing and sale; but fishermen strongly resent, as an interference with their calling, the imposition of a penalty for the landing and sale of a berried lobster. The Committee feels that the experiments which are being made in various countries in the artificial hatching of lobsters should be closely followed.

PARASITIC FUNGI IN BRITAIN.—The latest report on the occurrence of fungus, bacterial and allied diseases of crops in England and Wales, covers the three years 1922–1924 (G. H. Pethybridge, *Miscellaneous Publications* No. 52, Ministry of Agriculture and Fisheries). More diseases are listed than in the previous report, chiefly because additional host plants have now been admitted, these being mostly pasture and horticultural crops. Diseases which are new to the survey and in some cases new to Britain are indicated, and special reference is made to the downy mildew of the hop, *Pseudoperonospora Humuli* (Miy. and Tak.) Wilson, first noticed in Great Britain in 1920, which is now considered to be a probable native species which, up to the present, has been overlooked. Attention is also directed to the discovery that apple and pear scab are able to overwinter on dead fallen leaves and to produce on them their ascigerous stages which serve as centres for early spring infection. The concluding index of parasitic diseases is intended to provide as clear an idea as possible of the number and nature of the parasites associated with the crops dealt with in this survey, as a contribution towards a more complete list of British parasitic fungi than at present exists.

PENETRATION OF LIGHT INTO THE SEA.—The second number of the *Journal du Conseil International pour l'Exploration de la Mer*, published in May at Copenhagen under the editorship of Dr. E. S. Russell, continues the high standard of the first number, which was reveiwed in NATURE of May 22. In a paper by Dr. W. R. G. Atkins, researches are described dealing with the penetration of light into the sea and the increase in the coefficient of absorption on approaching land, owing to the presence of more particles in suspension. Since plant growth is dependent upon an adequate supply of light for the endothermic process of converting carbon dioxide into carbohydrates, the depth of the layer which is adequately illuminated is a major factor controlling the abundant flora of minute plants suspended in the water which the sea supports. As on land, the fauna are ultimately dependent upon the flora for their food supply, so a consideration of the conditions of plant growth in the sea is of fundamental importance for any inquiry concerning the fertility of particular areas of the ocean. The author also discusses the importance of the thermal stratification of the water, which restrains the mixing of bottom water, where the necessary phosphates and nitrates are regenerated from dead organisms, with the upper illuminated layers. An interesting point which has evolved is that a white disc let down into the sea is no longer visible from above after it reaches a depth at which the intensity of light is approximately one third of that in air at the surface.

AGES OF RADIOACTIVE MINERALS FROM AUSTRALIA.—The *American Journal of Science* for July contains a very interesting record of the analyses of Australian radioactive minerals compiled by Prof. L. A. Cotton. Unfortunately the lead-ratios are not given, and the ages are calculated from the formula $8000 \cdot Pb/(U + 0 \cdot 384\ Th)$ million years. The best modern data suggest that the factor 8000 should be about 6600. Making this correction, the pre-Cambrian mackintoshite and thorogummite from Wodgina are calculated to be about 1200 million years old. This result is probably a little high, for altered uranium minerals generally tend to lose more uranium than lead, proportionately. It agrees fairly well, nevertheless, with the ages of other minerals from the early Proterozoic era. The monazite from Normanville is also pre-Cambrian and gives a (corrected) age of 930 million years, a figure that agrees closely with the ages of permatitic minerals from Scandinavia, India, Ontario, and other localities. Results are given for other minerals, but as these are recognised to be altered, their evidence is not of immediate value for either age determinations or correlative purposes.

DUST IN MINES.—The Safety in Mines Research Board has issued its fourth annual report showing the researches in progress and the numerous subjects that are being dealt with, and including the report for 1925 of the Health Advisory Committee (London: H.M. Stationery Office, 1926. 1*s*. net). So far only

one research appears to have been completed, and a separate pamphlet, Paper No. 23 (Mines Department: Safety in Mines Research Board. Paper No. 23: A Method of Trapping the Dust produced by Pneumatic Rock Drills. By P. S. Hay. London: H.M. Stationery Office, 1926. 6*d.* net), has been issued descriptive of it. It consists of an appliance for trapping the dust produced in rock drilling. As is well known, the fine dust produced in drilling siliceous rocks is a serious menace to the health of the men engaged in the work, being the source of the dangerous disease known as miners' phthisis. The invention consists of a cap placed over the hole which is being drilled, the cap being connected by a suitable flexible pipe to a filter bag, whilst the necessary suction is produced by the exhaust air from the rock drill. Experiments tried with the appliance in actual underground mining operations have been highly satisfactory, and seem to have demonstrated that the apparatus is practical and convenient, and that by its use the air within the working in which the drilling is being done can be kept free from dangerous dust particles, so preventing any risk to the health of the men engaged in the work.

THE GROWTH OF SURFACE TENSION IN SOLUTIONS OF COMMON SALT.—The growth of the surface tension in newly formed surfaces of pure water has been investigated by Messrs. Hiss, Schmidt and Steyer, and Dr. E. Kleinmann in the *Annalen der Physik*, June 2, describes measurements, using the same method, on solutions of common salt. A tube with a fine and accurately measured opening at the top dips in the liquid, which can be raised and lowered on a slide. A stream of air blown horizontally across the opening causes the liquid to rise through the same, where it is blown away in spray. The air stream can be cut off electrically by means of a contact carried on a Helmholtz pendulum, which has a second movable contact producing an electric spark to illuminate the hole shortly after the air current has been shut off. The newly formed meniscus can be observed by means of a microscope, and its behaviour shows that the increase in surface tension follows an exponential law, the full value being reached in a small fraction of a second. The differences between the behaviour of water and salt solutions are studied, and some theoretical conclusions are drawn.

ALUMINIUM ANODE FILM DIELECTRIC.—It is known that various types of electrolytic cell possess unilateral conductivity, that is, they allow the electric current to pass through them much more readily when it flows in one direction than when it flows in the other. Such a device can be used to rectify alternating current into current pulsating in one direction. When we have, for example, one electrode of aluminium and one of some other conducting substance in a bichromate solution, then, when the aluminium electrode is at the higher potential, practically no current flows through the cell, provided that the potential difference is less than a certain critical value. When the potential difference is reversed a large current flows. Devices of this nature are largely used for 'lightning' arresters in electric traction. Mr. Subramanian has published in vol. 8B of the *Journal of the Indian Institute of Science* an interesting paper on the aluminium anode film dielectric. He finds that the leakage resistance of the film formed on the aluminium electrode is inversely proportional to the applied voltage for a given formation voltage and is directly proportional to the formation voltage. This resistance also is nearly independent of the frequency. The film when subjected to a voltage exceeding the critical value collapses, the breakdown being accompanied by flashes of light and crackling sounds, the pitch of which appears to be an octave higher than the frequency of the supply voltage. The electrostatic capacity of the double film in ammonium borate increases slowly with the time.

THE SYNTHESIS OF NITROUS OXIDE.—The first direct synthesis of nitrous oxide has been carried out by a method due to D. L. Chapman, R. A. Goodman and R. T. Shepherd, which is described in the *Journal of the Chemical Society* for June 1926. The gas is obtained when nitrogen at low pressures is submitted to an electric discharge in a quartz tube, the walls of which have been impregnated with oxygen by means of the discharge. The gas is analysed by heating a platinum wire in it, when the volume increases in the ratio of 2 to 3. When the decomposition products are exploded with hydrogen, it is found that the proportion of nitrogen to oxygen is 2 to 1, leaving no doubt that the gas is nitrous oxide.

DETONATION TEMPERATURES IN CLOSED VESSEL EXPLOSIONS.—No. 1005 (E. 17) of the Reports and Memoranda of the Aeronautical Research Committee (Note on 'Detonation' Temperatures in Closed Vessel Explosions, by R. W. Fenning. I.C.E. 519. London: H.M. Stationery Office, 1926. 6*d.* net) supplements a former report on the temperature and pressure of the unburnt residue of the charge at the start of detonation in closed vessel explosions. The records of the experiments performed by R. W. Fenning make it quite clear that the chief factor in the production of explosions in mixtures of air with petrol, hexane, pentane or heptane is the temperature, the pressure having little or no effect.

THE PHOTOCHEMICAL DECOMPOSITION OF SILVER IODIDE.—The microbalance has been used by E. J. Hartung to study the photochemical decomposition of silver iodide. Thin layers of silver, chemically deposited on vitreous silica sheets, were iodinated and the films of pure iodide exposed to sunlight in oxygen, hydrogen, and nitrogen respectively at different pressures in the presence of silver, which was used as an iodine absorbent. The results of these experiments, and those on the rate of iodination of silver and previously insolated silver iodide, are published in the *Journal of the Chemical Society* for June 1926. They show that the decomposition into silver and iodine takes place in the absence of oxygen, the maximum percentage loss of iodine being, in hydrogen 91·6 per cent., in nitrogen 88·5 per cent., and in oxygen 94 per cent.

THE SLOW OXIDATION OF PHOSPHORUS TRIOXIDE.—The product of the luminescent oxidation of phosphorus trioxide has hitherto been assumed to consist of phosphorus pentoxide. A paper published in the *Proceedings of the Royal Society of Edinburgh*, Vol. 46, part 2, No. 21, describes the work of C. C. Miller, which proves that under certain conditions the tetroxide is produced. Phosphorus trioxide in the presence of water vapour of 0·1 mm. pressure from 98 per cent. sulphuric acid was submitted to the action of oxygen at a pressure of 600 mm. and at a temperature of 25°. The light snow-like solid was shaken into a weighed tube and analysed by oxidising the water solution with potassium bromate, treating with hydrochloric acid and excess of potassium iodide, the liberated iodine being titrated with sodium thiosulphate. The total phosphorus was obtained by precipitation as magnesium pyrophosphate after the solution had been boiled with strong nitric acid to remove halogens. The analytical results were confirmed by microscopic investigation of the resublimed crystals.

The Gustatory Sensory Reflex.

We have already referred to certain of the researches carried out on the special senses by F. Allen and his collaborators in describing his investigation of the tactile sensory reflex. A recent paper on the gustatory sensory reflex presents an analysis of the sense of taste, the last of the 'five' special senses to be examined by this author, using the method which has proved so successful in the case of the senses of vision, hearing and touch; the sense of smell has so far defied investigation in this manner (F. Allen and Mollie Weinberg, *Quart. Journ. Exp. Physiol.*, 15, 385, 1925). The results obtained agree with what is known at present of the sense of taste, and, moreover, can be expressed by a formula which is closely related to those derived for the other three senses investigated.

The method used in all these researches is the determination of the fusion point of interrupted stimuli applied to the end-organ concerned. Thus in vision it is the critical frequency of flicker of the colour which is determined; in sound, the critical frequency of pulsation of the tone; and in touch, the critical frequency of percussion, by means of an interrupted blast of air; so in taste, the critical frequency of an interrupted electrical stimulus applied to the tongue is observed, using varying intensities of stimulation. The authors chose electrical stimulation of the tongue, which produces a sensation of sourness, as the most satisfying method of stimulating the taste-buds, the end-organs of taste, which are found in large numbers on the circumvallate and fungiform papillæ on the dorsal surface of the organ; their method requires the application of a stimulus of definite intensity to the same point at equal intervals of time and lasting only a definite fraction of a second. It is obvious that the mechanical application of substances in solution cannot be utilised for this purpose. In taking readings the tip of the tongue was protruded into a small mouthpiece containing the stimulating electrodes, the negative being applied to the dorsum and the positive to the under surface, so that the current ran through the tissue of the tongue itself; each measurement was completed in from two to three and a half seconds.

The results obtained, using different strengths of stimulation from 0·2 to 0·7 volt, at first sight appeared very irregular, but when plotted, with duration of the stimulus at the critical frequency as ordinate and intensity as abscissa, the readings were seen to fall along four curves, convex towards the abscissa: thus there are four fusion points for each strength of the stimulus. Since only four primary taste sensations are recognised, it was extremely probable that each of these curves represented the arousal of one of these sensations. The curve for the sour sensation was taken as the one on which the greatest number of points fell, since the actual stimulus used gave rise to this sensation. The identification of the other curves required special experiments.

It is known that gymnemic acid abolishes temporarily sweet and bitter sensations; after the application of a 0·5 per cent solution to the spot on the tongue at which the measurements were made, only two complete curves and a portion of another were obtained. None coincided with any of the normals; their position indicated depression of the receptors in the tongue. The authors considered that the incomplete curve corresponded to the bitter sensation, the receptors of which only responded to relatively strong stimulation, and that the normal curve, above which this portion lay, was the curve of bitter sensation; the remaining two curves then represented the depressed sensations of sour and salt, and assuming they were equally depressed, the normal curve for the latter could be placed; the remaining curve, unrepresented after gymnemic acid, must be that of the sweet sensation. The curves fall into the following order, commencing with the most sensitive: bitter, sour, salt, sweet; the duration of stimulation at the fusion point, using 0·2 volt as stimulus, is from 0·0015 sec. to 0·0025 sec. (bitter and sweet respectively, with sour and salt giving intermediate values). With 0·7 volt the four curves approach one another with a duration of stimulation at the critical frequency of the order of 0·005 sec. The correctness of the identification of the curves is confirmed by the fact that the receptors for the four sensations, when investigated by tasting solutions of different strengths, can be placed in the same order of relative sensitiveness.

It may be noted that the fusion point of the electrical stimuli in any given experiment cannot be predicted; in fact, it may change during its course. Since the stimulation produces a sour sensation, but at the same time affects the receptors of the other sensations, it is probable that every gustatory stimulus affects the four sets of receptors in varying degree, stimulation of one set, however, predominating.

The effects of previous stimulation of the same or opposite side of the tongue upon the position of the fusion curves were also studied. The application of a weak solution of quinine bisulphate to either side of the tongue resulted in depression of all four sensations; that is, at a given voltage, fusion of the stimuli was obtained with a longer duration of each stimulus. Acetic acid applied to the same side of the tongue depressed all sensations except sweet, but applied to the opposite side, it produced an enhancement of all sensations. A solution of 10 per cent. sodium chloride depressed the sour, and bitter, and especially the salt, sensations, after homolateral application, but enhanced the sweet. Between strengths of stimulation represented by 0·4 volt and 0·6 volt this enhancement was very marked. A 20 per cent. solution applied to the opposite side of the tongue resulted in enhancement of all four sensations. Enhancement was also caused by a 20 per cent. cane sugar solution applied to the same side as the stimuli, but with 5 per cent. solution depression of the sweet, salt and sour sensations occurred.

It is thus clear that previous stimulation of a gustatory end-organ leads to a change in sensitiveness both of itself and of neighbouring end-organs, which may be in the direction of either depression or enhancement. The authors explain these results by postulating the release of efferent impulses to the end-organs following the receipt of the afferent impulses in the central nervous system; the efferent impulses are of two kinds, causing depression and enhancement of the receptors, and according as one set prevails over the other, so is the end-organ depressed or enhanced: a weak stimulus results in depression, a strong in enhancement.

The fusion curves correspond to the equation

$$\frac{1}{D} = -K \log Q + C,$$

where $1/D$ is the reciprocal of the duration of the stimulus at the critical frequency of gustation (or fusion point), Q is the quantity of electricity, and K and C are constants. This equation is closely related to those found by the same method of experimentation for vision, hearing and touch: in vision the negative $\log Q$ is replaced by the positive logarithm of the intensity of the light stimulus; in hearing and touch, the duration of the stimulus replaces its reciprocal, and in the former the logarithm of the air pressure is

positive, in the latter negative; in these latter two, low intensities of stimulation produce enhancement, and the higher the reverse.

When the logarithmic curves are plotted it is found that they are straight lines with two abrupt changes of slope. In their previous communication, Allen and Hollenberg (*ibid.*, vol. 14, p. 351, 1924) described only two instead of three branches in the curves of the tactile sensations. Allen and Weinberg have reinvestigated this point (*ibid.*, vol. 15, p. 377, 1925), and find that the superficial pressure sense certainly conforms with the other senses in showing three branches in its logarithmic curve, and that the deep pressure sense shows a curve of similar nature, though the lowest branch is missing, probably because the apparatus used was incapable of delivering a sufficiently rapid series of air-puffs to reach the critical frequency at low air pressures. It appears, then, that the sense of pressure agrees in its general characteristics with the other three senses investigated. To obtain results with low air pressures the authors found it necessary to use a more sensitive surface than the palmar aspect of the forefinger, and so carried out their experiments on the lip.

The similarity of the results obtained in the case of the four senses of sight, touch, hearing and taste, together with the shapes of the logarithmic curves, suggests that the sensitivity of the receptive end-organs is under the control of the nervous system in each case. This sensitivity can be increased or diminished by stimulation of any of the receptors, the enhancement or depression affecting not only the receptors stimulated but also, by reflex action, the others which are at rest.

International Ornithological Congress at Copenhagen.

THE sixth International Ornithological Congress was held in Copenhagen on May 24-29, Dr. Ernst Hartert being the president. It should have taken place in Sarajevo in 1915, but, this being impossible, Copenhagen was chosen, where local ornithologists, Herr Lehn Schiöler, Prof. Wesenberg-Lund, and Mr. Bovien, the secretary, made excellent arrangements. The meetings took place in the splendid rooms of the Parliament Building (in the Christiansborg castle), kindly put at the disposal of the Congress by the Danish Government. More than 200 members were announced, but only 164 actually attended. Nearly all European countries were represented, as well as the United States of America, Argentina, Canada, Brazil, Cuba, India and Japan. Next to Denmark, Germany was by far the most strongly represented country, and 18 British members were present.

More than 50 papers had been announced of which 47 were read; time being too short to read all, those authors who were present were given preference. The lectures were divided between the general meetings and five sections: Section (1): Systematic ornithology, geographical distribution, palæontology; (2) anatomy, physiology, heredity and evolution; (3) biology, including ecology and bird-migration; (4) oology, nidification; (5) bird-protection and aviculture. These five sections were amalgamated into two or three, as there were no or only single papers on several of the subjects.

The president opened the first general meeting with an address (in German) on the progress and development of ornithology since 1910 (the last congress). In another meeting he spoke (in English) on "A Plea for More Scientific Collecting and Labelling." Other systematic papers were, among others: Stresemann (Berlin) on distribution and grouping of some African groups of birds; Heim de Balsac (Paris) on the supposed identity of *Cinclus cinclus* L. and *Cinclus cinclus aquaticus* Bechst; Lönnberg (Stockholm) on the origin of the North American fauna; Sushkin (Petrograd) on hybrids of shrikes and of thrushes, and on a peculiarity of adaptive evolution in the insular faunæ; Chapman (New York) on the biological significance of altitudinal life zones; Rensch (Berlin) on the justification of ornithological systematic principles in other branches of zoology; Neumann (Berlin) on the genus Alisterus (New Guinea parrot); Murphy (New York) on the adaptive variation of the Tubinares. Of other papers might be mentioned Lucanus (Berlin) on the mental life of birds; Gröbbels (Hamburg) on various anatomical subjects; Verwey (Utrecht) on the biology of the heron in the pairing season, and on a fulmar with feathered feet; Boas (Copenhagen) lectured on the neck of birds.

Great interest was manifested in bird migration, and a number of papers dealt with this subject, especially Götz (Stuttgart) on relations between moult and migration, Drost (Heligoland) on migrations in the winter months, Geyr von Schweppenburg (Münden) on the migrations of *Sylvia curruca* (Lesser Whitethroat), Schenk (Budapest) on the value and elaboration of dates of migration, Weigold (Hanover) on bird migration on Heligoland, Jägerskiöld (Gothenburg) on bird ringing by the Gothenburg Biological Society. Hörtling (Finland) dealt with ornithological explorations in Finland, and Fleming (Toronto) with the Arctic collections in the Canadian National Museum.

A somewhat prominent feature of the Congress were the numerous lantern slides and the wonderful films, which were shown in the large and beautiful 'Palace Theatre.' Unforgettable will be the motion pictures from the Bird Islands of Chile and Peru by Drs. Frank M. Chapman and Murphy (New York), on the development of the young of Central European birds by Heinroth (Berlin), and, last but not least, on the last evening, Bengt Berg's films from the Upper White Nile, showing the wonderful bird life in those countries, among others the masses of migrants and the *Balæniceps rex* as well as large herds of elephants, etc. Gröbbels (Hamburg) attempted to explain the physiology of the flight of birds on a film. Lectures by Meinertzhagen (London) on bird life in the Himalayas, Jespersen (Copenhagen) on the frequency of birds over the High Atlantic Ocean, Jourdain (Ditchingham) and van Oordt (Utrecht) on the bird life of Spitsbergen, Krabbe (Copenhagen) on eider-ducks and Greenland falcons, by Helms and Hörtling and others, were accompanied by excellent lantern-slide projections. Lectures by Schoenichen (Berlin) and others dealt with bird protection

Rather amusing and interesting were the imitations of birds' notes and song by Stadler and Preiss (Nürnberg), partially by mouth and partially with the help of instruments.

Much hospitality was shown to the members of the Congress. A half-day excursion took place in chars-à-bancs over a great part of Seeland, by the ancient renaissance castles Helsingör (Elsinore) and Frederiksborg to the estate of the enthusiastic bird-lover Herr Jarl, who is protecting his park and wood as a Nature reserve. Many members listened there for the first time to the powerful song of the 'Sprosser' or northern nightingale. The Minister of Foreign Affairs invited the Congress to a sumptuous tea in the rooms of the Royal Rifle Club and adjoining gardens. The

art-mæcenas Herr Jacobsen invited the Congress to his place at the Carlsberg Brewery. In the 'theatre' the lectures of Stadler and Preiss were delivered, a sumptuous Danish supper was served in one of the rooms of the Art Gallery, and the promenade through the extensive gardens, in the light of the full moon and lit up by numerous lanterns and torches, will long remain in the memories of those present.

Another feature of great scientific interest was the visit to the collections in Herr Schiöler's hospitable house. These collections, more or less limited to the Danish possessions, including Greenland and Iceland, are a masterpiece of completeness. All birds are represented by some beautifully mounted specimens and numerous skins, as well as very large series of skeletons, and anatomical preparations. The collection is in every way as it should be, though such completeness can at present only be reached in birds from a limited area, and is the work of a lifetime. A morning was spent in the Zoological Museum of the University, where lectures and discussions took place.

Invitations for the seventh International Ornithological Congress had come from Tunis, Finland, and Holland. A small number of the members of the International Committee voted for Tunis, others for Finland, but an overwhelming majority for Holland. The general meeting of the Congress adopted, therefore, Holland, where the next Congress is to take place in 1930, in the large and comfortable new Colonial Institute in Amsterdam

The Lister Institute of Preventive Medicine.

THE annual report which was presented by the governing body of the Lister Institute to the meeting of members held on June 9 records another year of satisfactory progress. There has been only one substantial change in staff: Dr. A. T. MacConkey, who has been in charge of the serum laboratories at Elstree for twenty years, has retired, and is succeeded by Dr. G. F. Petrie. Dr. Muriel Robertson, after several years of absence through ill-health, has returned to work and will restore the protozoological laboratory to a working department. The activities of the staff are augmented by workers maintained by the Medical Research Council, the Foot-and-Mouth Disease Research Committee, the Rockefeller Foundation, the British Empire Cancer Campaign, and others who find in the Institute the facilities and atmosphere which they need.

Under Prof. Ledingham, the bacteriological department has pursued a variety of researches. Particular notice should be made of the inquiries into the invisible viruses of smallpox, vaccinia, and foot-and-mouth disease, and of those, due chiefly to Dr. J. A. Arkwright and Mr. Bruce White, into the variation and biochemical structure of the food-poisoning and other bacteria—questions which have an important bearing on the conception and differentiation of 'species.' The systematic classification, nomenclature, and identification of bacteria, upon which all good physiological and pathological work with them ultimately depends, are cared for by the National Collection of Type Cultures, maintained at the Institute by the Medical Research Council.

The biochemical department in charge of Prof. Harden, who has also acted as director of the Institute during Prof. C. J. Martin's absence on sick leave, has been continuing its work on hexosephosphates and alcoholic fermentation and on the concentration and possible isolation of vitamins; Dr. Zilva is supervising the preparation of large supplies of concentrated lemon juice for the Antarctic whaling expedition. Dr. Robison is following up his important discoveries of the phosphoric esters in blood and tissues and their hydrolysis by specific enzymes.

The department of experimental pathology is energised by the director and Dr. Chick, and in various directions they have extended the investigations of accessory food factors for which the laboratory is now so well known. Refinements of knowledge have led to technical difficulties, and the distinction which must now be made between vitamin A (which promotes growth) and the antirachitic vitamin D has made a good deal of previous work unsatisfactory and new experiments more and more complex. Dr. Boas has made the significant discovery that dehydration, however it is carried out, makes egg-white quite unsuitable as a sole source of protein, and indeed seems to confer on it almost poisonous properties. Long and laborious observations on the nutritional qualities of cows' milk show that diet is the important factor in determining its content in vitamin A, while the amount of sunlight the animal gets is the chief thing which influences the antirachitic value of its milk.

The finances of the Institute are superficially in good order, the past year's work leaving a balance of 14,000*l*. But the position is actually far from what it should be, for of a total income of 51,000*l*. no less than 36,000*l*. was derived from diagnosis fees and the sale of sera and vaccines. The demand for these products naturally varies with the vagaries of epidemics in different parts of the world, and the precarious nature of the income so obtained must hamper the governing body in extending the activities of the Institute along lines which involve long or permanent commitments. A reduplication of Lord Iveagh's splendid benefaction is much needed.

University and Educational Intelligence.

LONDON.—The following doctorates have been conferred:—*D.Sc.* (*Applied Statistics*) on Mr. G. M. Morant (University College) for a thesis entitled "A Study of Egyptian Craniology from Prehistoric to Roman Times"; *D.Sc.* (*Biochemistry*) on Mr. J. H. Quastel (Imperial College—Royal College of Science) for a thesis entitled (1) "The Relationship of the Chemistry of Resting Bacteria towards Bacterial Growth," and (2) "A Theory of the Mechanism of Oxidations and Reductions *in vivo*"; *D.Sc.* (*Zoology*) on Mr. F. W. R. Brambell (University College) for a thesis entitled "Oogenesis of the Fowl (*Gallus bankiva*)"; *D.Sc.* (*Engineering*) on Mr. E. Mallett (Imperial College—City and Guilds College) for a thesis entitled "Forced Oscillations, Electrical and Mechanical"; *D.Sc.* (*Geology*) on Mr. F. Raw for a thesis entitled "The Development of *Leptoplastus Salteri* and other Trilobites"; *D.Sc.* (*Physics*) on Dr. R. L. Smith-Rose for a thesis entitled "Some Recent Research in Wireless Direction Finding," and other papers; *D.Sc.* (*Zoology*) on Miss N. B. Eales for a thesis entitled "The Anatomy of the head of a Fœtal African Elephant," and other papers.

THE League of Nations' International Committee on Intellectual Co-operation held its eighth plenary session at Geneva on July 26-29 under the presidency of Prof. Lorentz. The British Empire was represented by Prof. Gilbert Murray and Sir J. C. Bose. Among the subjects discussed were: the means for securing profits for scientific workers in connexion with the industrial application of their discoveries, the organisation of an international system of scholarships for the promotion of science, the foundation of an international university for the training of

statesmen, diplomats, the study of political science, etc., the co-ordination of scientific bibliography, the foundation of an international meteorological office, and the establishment of an international museum office to improve the organisation of catalogues and promote mutual assistance by loans, exchanges, distribution of photographs, etc. Sitting as governing body of the International Institute of Intellectual Co-operation, the committee received its report, adopted a programme and drew up a budget. The Institute will have at its disposal this year the French Government's subsidy of two million French francs, the Polish Government's grant of 100,000 French francs and the Czechoslovak Government's subsidy of 15,000 gold francs. The committee emphasised the necessity of setting up national university information offices in countries where they do not already exist. It was decided to study the possibility of convening in 1927 a meeting of representatives of national committees of intellectual co-operation.

UNIVERSITY tutorial class (extra-mural) teaching and its problems form the subject of a paper by Mr. R. S. Lambert, hon. secretary of the Association of Tutorial Class Tutors, published in the June number of the *Bulletin of the Association of University Teachers*. The writer points out that as the classes are largely organised by the Workers' Educational Association, nearly every tutor finds himself connected with this body, becomes a member of it, shares in its propaganda, and finds many opportunities for service as a speaker in the meetings of trade union branches, cooperative societies and guilds, working men's clubs, etc., which form the students' recruiting ground. About half the classes are, he says, taken by lecturers holding a salaried post within a university, who take a single class or two classes, in addition to their internal work, or instead of part of it, and are paid a fee per class (8*l*. as a rule). The other half are taken by tutors giving the whole or a greater part of their time. Of these, about twenty-five hold permanent salaried posts as 'staff tutors' under the various Joint (University and W.E.A.) Committees, and thirty have no guaranteed salary or status, but are dependent for their livelihood on fees paid according to the number of classes they happen to be taking. The work is both physically and mentally exacting, and four or five classes per week (each class meets twenty-four times during the year) are enough to occupy a man's entire energies. It is clear that these extra-mural classes of adult three-year students constitute vitally important areas of contact between the universities and the community, and their development, which is proceeding rapidly, needs very close attention.

COMPARATIVE statistics of German university students in 1914 and 1925 show very remarkable changes in distribution among the various faculties. Students of medicine, the humanities, mathematical and natural sciences, and evangelical theology comprised in 1914 respectively 25, 21, 11, and 7 per cent. of the total numbers; in 1925 these percentages had shrunk to 11·5, 16, 8, and 3. Students of law, of political science, and of chemistry, on the other hand, increased from 17, 4, and 1 per cent. to 28, 15·5, and 5 per cent. The total number increased during the same period from 69,644 to 81,699, this last figure being smaller by nearly eight thousand than the corresponding figure for 1924. These statistics are taken from "Academicus," a useful handbook of information about German universities and polytechnics. The 1926 issue (published by Alfred Lorentz, Leipzig, price M2.40) includes, for the first time, particulars of the German-speaking institutions of Austria and Czechoslovakia.

Contemporary Birthdays.

August 14, 1861. Sir Richard Threlfall, K.B.E., F.R.S.
August 14, 1860. Dr. Arthur Prince Chattock, F.R.S.
August 15, 1842. Sir William A. Tilden, F.R.S.
August 15, 1871. Prof. Grafton Elliot Smith, F.R.S.
August 16, 1863. Prof. Frederic Stanley Kipping, F.R.S.
August 18, 1831. Mr. Ernest Noel, F.G.S.
August 19, 1868. Prof. William Bulloch, F.R.S.

Sir RICHARD THRELFALL, who was born at Hollowforth, Lancashire, was educated at Clifton and Caius College, Cambridge. He is chairman of the Fuel Research Board.

Dr. CHATTOCK was born at Solihull, Warwickshire. He is emeritus professor of experimental physics in the University of Bristol.

Sir WILLIAM TILDEN, the veteran chemist, to whom we offer our very hearty congratulations on the celebration of his eighty-fourth birthday, was born in London. Formerly a science master at Clifton College, he occupied next the chair of chemistry at Mason College, Birmingham. On leaving there he became professor of chemistry at the Royal College of Science, London, retiring in 1909. The Royal Society had awarded him in the previous year its Davy medal for his discoveries in chemistry. Sir William gave the Mendeléeff Memorial Lecture before the Chemical Society, in 1909, in all respects a masterly exposition. Incidentally, we may recall that Mendeléeff's last appearance in London was in November 1905, when he attended to receive the Copley medal of the Royal Society.

Prof. G. ELLIOT SMITH was born at Grafton, N.S.W., and educated at the Universities of Sydney and Cambridge. Formerly professor of anatomy in the University of Manchester, he now occupies a similar chair in University College (University of London). In 1912 the Royal Society awarded him a Royal medal in recognition of distinctive investigations on the comparative anatomy of the brain. Prof. Elliot Smith is the author (among many works) of "The Evolution of Man" (1924), and holds original views on the origin and diffusion of culture.

Prof. KIPPING was born at Manchester and educated there at the Grammar School, at Owens College, and at the University of Munich. For some time he was on the teaching staff of Heriot-Watt College, Edinburgh, and next became a lecturer in chemistry at the Central Technical College, London. In 1897 Prof. Kipping was appointed to the chair of chemistry in University College, Nottingham. The Royal Society awarded him its Davy medal in 1918 for his investigations in organic chemistry.

Mr. ERNEST NOEL, who is in his ninety-fifth year, is the *doyen* of the Geological Society of London. Educated at Edinburgh and Trinity College, Cambridge, he was elected into the Geological Society in 1849, and thus has been seventy-seven years on its roll.

Dr. WILLIAM BULLOCH was born at Aberdeen and educated there at the University. Formerly assistant professor of pathology in University College, London, he has been, since 1919, Goldsmiths' professor of bacteriology in the University of London. He is Hon. LL.D. Aberdeen.

Societies and Academies.

PARIS.

Academy of Sciences, July 5.—Gabriel **Bertrand** and M. **Mâcheboeuf**: The influence of nickel and cobalt on the action exercised by insulin on the dog. The results of experiments carried out on the rabbit have been given in an earlier communication: it is now shown that the addition of cobalt and nickel to insulin causes similar effects on the dog and rabbit. There is an increase in activity in both animals; cobalt has a greater influence than nickel.—Gaston **Julia**: A series of polynomials connected with the conformal representation of simply associated areas.—Luigi **Fantappiè**: Analytical functionals which are functions of a finite number of linear functionals.—René **Lagrange**: Legendre functions of the first species and certain associated functions.—N. **Gunther**: The movement of a liquid filling a simply associated domain which is displaced.—Henri **Bénard**: The deviations of the values of the frequency of vortices alternating with respect to the law of dynamical similitude.—Th. **De Donder** and Fr. H. **van den Dungen**: The quantification deduced from Einsteinian gravific.—Léon **Brillouin**: The undulatory mechanics of Schrödinger, a general method of resolution by successive approximations.—W. H. **Keesom**: Solidified helium (*v.* NATURE, July 17, p. 81).—Jean **Lecomte**: Infra-red absorption spectra of cyclic derivatives. The infra-red absorption spectra of derivatives of benzene, cyclohexene, and cyclohexane have been compared and numerical data are given.—René **Lucas**: The rotatory power of tartaric acid. The effects of the addition of such substances as boric acid, tungstic acid, urea, etc., can be explained as being due to the appearance of one new form, strongly dextrorotatory, and in proportions varying with the reagents. It is possible that the anomalies of malic acid follow a similar mechanism.—P. **Daure**: The qualitative study of the fluorescence of bromine vapour.—R. de **Mallemann**: Magnetic rotatory dispersion and the dispersion of electric double refraction. From theoretical considerations it is concluded that the ratio of Verdet's constant to Kerr's constant should vary inversely as the wave-length, or, alternatively, the ratio of the magnetic rotatory dispersion to the dispersion of electric double refraction should be equal to the corresponding ratio of wave-lengths. This conclusion is verified experimentally for carbon disulphide and for camphor in hexane solution.—Paul Gabriel **Girault**: A possible influence of commutation on the stability of continuous current machines.—Georges **Fournier**: The absorption of β-rays by matter.—D. P. **Konovalov**: The heats of combustion of some hydrocarbons. Values are given for the heats of combustion of cyclohexene, methylenecyclohexane, and dicyclohexane and the figures compared with those calculated from a formula given by the author in an earlier paper.—A. **Boutaric** and G. **Corbet**: On the critical temperature of solution of acrolein and water and on the molecular mass of soluble acrolein resin. The soluble acrolein resin studied is a polymer of ten molecules of acrolein.—— **Surun**: The estimation of the adsorbing power of carbons.—E. **Rouyer**: The determination of some double salts in solution by the boiling point method. Experimental data for the double sulphate of ammonium and RSO_4, where R is cadmium, iron, cobalt, manganese, zinc, magnesium, copper, and nickel, and also double chlorides of the carnallite type.—— **Holweck**: The spectrometry of the *K* series of the light elements. The *K* discontinuity of fluorine. The advantages of the method of critical potentials are emphasised; it brings out the *K* discontinuity of fluorine at 684·2 volts very clearly. By combining the results of several workers, the Moseley curve from helium to sulphur is shown to be a straight line.—V. **Ipatief** and A. **Andreevsky**: The displacement of platinum by hydrogen under high pressures. The precipitation of platinum from its solutions by hydrogen is a function of the temperature, pressure, concentration, and time, and results of experiments in which each of these factors was varied are given. The presence of metals such as iron and nickel, especially in acid solution, tends to retain platinum in solution.—Daniel **Florentin**: The estimation of soluble silica in cements, mortars, and concretes.—Georges **Denigès**: The action of concentrated hydrobromic and hydriodic acids on the cobalt ion. A new reaction for nickel. A description of new colour reactions of cobalt with concentrated hydrobromic and hydriodic acids and of nickel with concentrated hydriodic acid.—André **Job** and Antoine **Cassal**: The fixation of carbon monoxide on an organic magnesium compound by means of chromic chloride. A solution of phenylmagnesium bromide is without action upon carbon monoxide, but the addition of anhydrous chromium chloride causes an immediate absorption of the gas. From the products of this reaction benzopinacone, benzophenone, benzhydrol, diphenyl, diphenyl-acetophenone, and benzaldehyde were isolated. Some chromium-carbonyl is also produced.—Marcel **Delépine**: A supposed isomer of methylene-amino-acetonitrile. Methylene-bis-iminodiacetonitrile. The substance previously described as an isomeride of methylene-aminonitrile is proved to be the methylene derivative of imino-diacetonitrile.—Emile **Votoček** and F. **Valentin**: The optical inverse of natural rhamnose. Starting with isorhodeonic acid, *d*-rhamnose has been prepared; it has all the properties of natural rhamnose except that its rotation is of opposite sign.—F. **Salmon Legagneur**: The action of ethyl-magnesium bromide on the methyl ether of the α-mononitrile of camphoric acid. The products of the reaction are α-ethylidene-camphidone and a secondary nitrile alcohol.—Octave **Bailly** and Jacques **Gaumé**: The synthesis and hydrolysis of glyceromonophosphoric di-ester; α,β-diglyceromonophosphoric acid and the constitution of orthophosphoric acid.—René **Delaplace**: The preparation of cæsium eosinate. Cæsium hydroxide is treated with the theoretical quantity of acid eosin to prepare the eosinate. Details are given of the preparation of the eosin and of the cæsium hydroxide, together with the method of recovering the cæsium.—— **Viret**: New observations relating to the rodent fauna of Saint-Gérand-le-Puy.—Mlle. G. **Bonne**: The nature of the floral section in the Chrysobalaneæ.—M. **Bridel** and C. **Béguin**: A new glucoside, hydrolysable by rhamnodiastase, extracted from the fresh flowers of *Ulex europæus*. Details of the extraction, chemical and physical properties of a new glucoside, to which is given the name ulexoside. This gives the methylpentose reaction, and can be hydrolysed by rhamnodiastase giving a sugar and ulexogenol.—A. **Sartory**, R. **Sartory**, and J. **Meyer**: The study of the action of radium on *Aspergillus fumicatus* in culture on dissociated and non-dissociated media.—M. and Mme. A. **Chauchard**: The action of curare on the electrical apparatus of the torpedo (*Torpedo marmorata*). The curarisation of the electrical apparatus of the torpedo necessitates the use of relatively large doses of curare. The poison does not act on the nerve but on the electrical organ.—G. A. **Nadson** and M. N. **Meisl**: The mechanism of the action of chloroform on living matter. Description of the action of chloroform on

a yeast (*Saccharomyces Ludwigii*), the observations being so arranged that the same cell was studied throughout.—Pierre **Girard** and Edouard **Peyre**: The suppression of shock and modification of the anaphylactic sensibilisation by certain fluorescent colouring matters. The colloidal mechanism.—Charles **Pérez**: Some secondary sexual characters in Galathea.—Louis **Roule** and Léon **Bertin**: The development with complex metamorphoses (hypermetamorphosis) of *Nemichthys scolopaceus*.—Paul **Mathias**: The evolutive cycle of a trematode of the family of the Echinostomidæ (*Echinoparyphium recurvatum*).—Robert **Regnier** and Roger **Pussard**: The constitution of the reserve stores of *Microtus arvalis* (field mouse), and its importance for the multiplication of this rodent.—E. **Aubel** and L. **Genevois**: Researches on the reduction of thionine by various organic substances, in the absence of air and light.—L. **Lutz**: The soluble ferments secreted by the Hymenomycetes. Oxidising actions.—J. **Sabrazès**: Spirochætes in experimental peritonitis by intestinal perforation in the guinea-pig.

CAPE TOWN.

Royal Society of South Africa, June 16.—K. H. **Barnard**: A study of the freshwater isopodan and amphipodan Crustacea of South Africa. A general account of the biology of *Phreatoicus capensis*, including a curious habit of æstivation, and certain tendencies to variation, is given *P. capensis* is closely allied to *P australis*; both forms are regarded as being the direct descendants of the ancestral stirps represented by the fossil species *wianamattensis*. A freshwater isopod of the family Jæridæ having affinities with the Australian genus *Heterias* is described Several new species of 'blind' gammarids are described; the localised habitat of these 'blind' species is contrasted with the wider distribution of the single black-eyed species *Phreatoicus capensis* is confined to old and mature valleys in the less highly tilted mountains, and is not found now outside the limits of the effective deposition of moisture from the clouds formed by the S.E Trade winds The finding of a fossil species of Phreatoicus shows that the tribe was both austrogenic and palaegenic, and rules out the theory of a migration of northern Crustacea via the Andes into Australasia—S H **Haughton**: The river system of S W. Gordonia: In the last few miles of its course, the Molopo River shows all the characters of rejuvenation impressed upon a mature stream—waterfalls, a winding deep gorge, and old river-gravels This rejuvenation is due to the recession of the Aughrabies Falls past the mouth of the Molopo and the consequent cutting-back of the Molopo Falls to their present position. There is no permanent stream in the Molopo now. The tributaries of the Orange to the west of the Molopo in Gordonia have arrived at a more mature stage, although they are deeply entrenched. The cessation of erosive action in S.W. Gordonia seems to have been an event of geologically recent date.—B. F J. **Schonland** and J. **Craib**: Measurements of the electric fields of thunderstorms. An observatory for the study of electrical meteorology was established on the farm Gardiol, near Somerset East, in January 1926, and a photographic recording apparatus similar to that designed by C. T. R. Wilson has been in use.

ROME.

Pontifical Academy of Sciences (Nuovi Lincei), May 24.—**Stein**: Double stars in the astrographic catalogue of the Vatican zone.—**Colonnetti**: Experimental investigations on elastic co-actions.—**Sesini**: Elastic co-actions.—**Pugno**: Study of the compensators in use in optical experiments on elasticity.—**Luigioni**: New species of blind coleoptera (*Duvalites Franchetti*) discovered by Baron Carlo Franchetti in a grotto near Subiaco (Central Italy).—**Luigioni**: The specific validity of *Anoxia sicula*.—**Pagnini**: The hypotheses serving as foundation for the undulatory theory of light.—**Palazzo**: Geophysical observations relating to the total eclipse of the sun.—**Palazzo**: The magnetic contour of Somaliland.—**Silvestri**: Pseudo-nummulites in the tertiaries of Tuscany.

SYDNEY.

Linnean Society of New South Wales, May 26.—Rev H. M. R. **Rupp**: Further notes on the genus Pterostylis. Records are given of five additional species, together with corrections and additions to some of the previous notes on the genus.—E. W. **Ferguson**: Revision of Australian Syrphidæ (Pt. 1). Little attempt has hitherto been made to deal systematically with the Australian species. Keys for the separation of the subfamilies, and for the identification of the species of Cerioides, Eristalis, Helophilus and Microdon are given. Twenty-three species are described as new.—P. D. F. **Murray**: An experimental study of the development of the limbs of the chick. Grafts on to the chorio-allantoic membranes of seven-day chicks, of the limb buds and fragments of limb buds of three-, four- and five-day chicks, and of limb *anlagen* at earlier stages, show the limb *anlagen* to have in a high degree the power of self-differentiation, their development being apparently independent of other regions of the chick, except for the blood supply. The limb bud is a mosaic structure Ends of skeletal elements may develop normal joint structures in the absence of the neighbouring element upon which the joint would normally work—R **Greig-Smith**: The influence of certain colloids upon fermentation (Pt. 3). Fuller's earth and aeration in the alcoholic fermentation Judging by the action of fuller's earth, the mineral colloids have an action of their own in accelerating the activity of yeast in the fermentation of dextrose. Their faculty of assisting the dispersal of dissolved carbon dioxide does not explain their action, for when the fermenting fluids were aerated, the colloid still hastened the fermentation.

VIENNA.

Academy of Sciences, June 17.—V. **Oberguggenberger**: The scintillation of the stars. A coarse diffraction grating was fixed to a telescope so that the grid was parallel to the daily motion. The telescope being fixed, the star traversed the field and showed a spectrum trace on the photographic plate. In this way the Innsbruck Observatory has examined the frequency of the scintillation.—G. **Rzimann**: The formation of organs from adventitious buds in *Tolmiea Menziesii*. An attempt to trace the influence of the ratio between carbohydrates and mineral salts in forming leaves or roots.—M. **Kofler**: A simple definition of the inconstancy of a natural phenomenon.—J **Pircher**: An apparatus for registering the squalliness of the wind connected to a Dines' anemograph.—V. **Conrad**: Fluctuations of seismic activity in various fold-regions.—A. **Wagner**: Wind registrations on the 150-metre high radio tower at Altenburg, Germany.—W. **Schmidt**: Experiments with models on the influence of the rotation of the earth on the course of rivers.

Official Publications Received.

Department of Scientific and Industrial Research. Second Report of the Gas Cylinders Research Committee (Periodical Heat Treatment). Pp. iv+29+13 plates. (London: H.M. Stationery Office.) 2s. 6d. net.

The National Physical Laboratory. Watch and Chronometer Trials, 1925. Pp. 5. (London: H.M. Stationery Office.) 6d. net.

Ceylon Administration Reports for 1925. Part 4: Education, Science and Art (F). Administration Report of the Government Marine Biologist for 1925. By Dr. Joseph Pearson. Pp. F16. (Colombo: Government Record Office.) 35 cents.

Ceylon. Sessional Paper 15, 1926: Reports on the Pearl Fishery of 1925. By Dr. Joseph Pearson. Pp. 80+11 plates. (Colombo: Government Record Office.) 2.25 rupees.

Proceedings of the Imperial Academy. Vol. 2, No. 5, May. Pp. viii-xviii+193-240. (Ueno Park, Tokyo.)

Proceedings of the United States National Museum. Vol. 69, Art. 3: Miscellaneous new Chalcid-Flies of the Hymenopterous Family Encyrtidae. By P. H. Timberlake. (No. 2629.) Pp. 34+2 plates. (Washington, D.C.: Government Printing Office.)

Methods and Problems of Medical Education. (Fourth Series.) Pp. ix+32+48. (New York City: The Rockefeller Foundation.)

Bulletin of the American Museum of Natural History. Vol. 56, Art. 3: The Skeleton of *Moschops capensis* Broom, a Dinocephalian Reptile from the Permian of South Africa. By William K. Gregory. Pp. 179-251+21 plates. (New York City.)

Journal of the Faculty of Science, Imperial University of Tokyo, Section 1: Mathematics, Astronomy, Physics, Chemistry. Vol. 1, Part 1: Theory of Generating Functions and its Application to the Theory of Probability. By Toyojiro Kameda. Pp. 62. 1.40 yen. Vol. 1, Part 2: Studies on Binary Mixtures. By Jitsusaburo Sameshima. Pp. 63-103. 1.10 yen. Vol. 1, Part 3: Über die Maximalordnung einiger Funktionen in der Idealtheorie. Von Zyoiti Suetuna. Pp. 105-153. 1.05 yen. Vol. 1, Part 4: Thermochemical Studies. By Hajime Hirobe. Pp. 155-222. 1.30 yen. Section 2: Geology, Mineralogy, Geography, Seismology. Vol. 1, Part 1: Tertiary Mollusca from Shinano and Echigo. By Matajiro Yokoyama. Pp. 23+7 plates. 1.60 yen. Vol. 1, Part 2: Podsol in South Saghalien, by Prof. Tetsugoro Wakimizu; Physiographical Studies of the Southeastern Part of Bosō Peninsula, by Prof. Naomasa Yamasaki; Brief Notes on Fergusonite and Allanite from Iyo, Shikoku, by Prof. Denzo Sato; Variation of Specific Gravity of Japanese Crude Oils, with Special Reference to their Geological Occurrence, by Prof. Tsunenaka Iki; The Cupriferous Pyritic Ore Deposits of the Shibuki and Seki Mines in the Province of Bungo, Japan, by Prof. Takeo Kato; The Genetical Interpretation of Extrusive Rocks, by Seitaro Tsuboi; A Tertiary Forerunner of Effusive Rocks in the Northeastern Japan, by Koroku Tsuboya; The Post-Paleozoic and Late-Mesozoic Earth-Movements in the Inner Zone of Japan, by Yoshiaki Ozawa; Zonal Growth of Plagioclase and Sodaorthoclase in Syenitic Magma, by Tei-ichi Ito. Pp. 25-109+plates 8-13. 2.00 yen. Vol. 1, Part 3: Mollusca from the Tertiary Basin of Chichibu. By Matajiro Yokoyama. Pp. 111-126+plates 14-15. 0.80 yen. Vol. 1, Part 4: Tertiary Mollusca from Shiobara in Shimotsuke. By Matajiro Yokoyama. Pp. 127-138+plates 16-20. 1.10 yen. Vol. 1, Part 5: A Dispersion Method of Discriminating Rock-Constituents and its Use in Petrogenic Investigation. By Seitaro Tsuboi. Pp. 139-180. 1.00 yen. Vol. 1, Part 6: The Cretaceous Formation of Futaba in Iwaki and its Fossils. By Shigeyasu Tokunaga and Saburo Shimizu. Pp. 181-212+plates 21-27. 1.70 yen. Vol. 1, Part 7: Molluscan Fossils from the Tertiary of Mino, by Matajiro Yokoyama; Neogene Shells from Kōzuke and other Provinces, by Matajiro Yokoyama; Tertiary Mollusca from the Oil-Fields of Embets and Etaibets, by Matajiro Yokoyama. Pp. 213-248+plates 28-32. 1.50 yen. Section 3: Botany. Vol. 1, Part 1: Über den Reifungsvorgänge des Pharbitis-Samens mit besonderer Rücksicht auf die Keimungsfähigkeit des unreifen Samens. Von Yoshiji Yoshii. Pp. 139+1 Tafel. 2.65 yen. Section 4: Zoology. Vol. 1, Part 1: Studies on some Nematode Parasites of Frogs and Toads in Japan, with Notes on their Distribution and Frequency, by Kaoru Morishita; On Two new Genera of Frog Trematodes, Cryptotrema and Microlecithus, and a new Species of Pleurogenes, by Yoshimasa Ozaki; The Anatomy and Development of a Rhizostome Medusa, *Mastigias papua* L. Agassiz, with Observations on the Phylogeny of Rhizostomae, by Tohru Uchida; Three new Species of Amphistomata from Mammals, by Tamao Fukui. Pp. 113+6 plates. 2.90 yen. Section 5: Anthropology. Vol. 1, Part 1: On the Cephalic Index and Stature of the Japanese and their Local Differences; a Contribution to the Physical Anthropology of Japan. By Akira Matsumura. Pp. 312+10 plates. 11.00 yen. (Tokyo: Maruzen Co., Ltd.)

New South Wales. Department of Mines: Geological Survey. Mineral Resources No. 34: A Contribution to the Mineralogy of New South Wales. By George Smith. Pp. 145+32 plates. (Sydney, N.S.W.: Alfred James Kent.) 3s. 3d.

Report of His Majesty's Astronomer at the Cape of Good Hope to the Secretary of the Admiralty, for the Year 1925. Pp. 10. (Cape Town.)

South Australia: Department of Mines. Mining Review for the Half-year ended December 31st, 1925. (No. 43.) Pp. 82+8 plates. (Adelaide: R. E. E. Rogers.)

The Cordwainers Technical College (Incorporated), Eagle Court, St. John's Lane, E.C.1. Prospectus of Classes in Boot and Shoe Manufacture and Making, and Leather Goods Manufacture: Day and Evening Classes, Session 1926-7. Pp. 42. (London.)

Journal of the Royal Statistical Society. New Series, Vol. 89, Part 3, May. Pp. viii+405-634. (London: Royal Statistical Society.) 7s. 6d.

Canada. Department of Mines: Mines Branch. Final Report of the Peat Committee appointed jointly by the Governments of the Dominion of Canada and the Province of Ontario: Peat, its Manufacture and Uses. By B. F. Haanel. (Mines Branch No. 641.) Pp. xviii+298+58 plates. (Ottawa: F. A. Acland.)

Agricultural Experiment Station: Michigan State College of Agriculture and Applied Science. Horticultural Section, Technical Bulletin No. 75: Influence of Nutrient Supply on Earliness of Maturity in Cabbage. By J. B. Edmond and E. P. Lewis. Pp. 16. (East Lansing, Mich.)

Proceedings of the American Academy of Arts and Sciences. Vol. 61, No. 5: Measurement of the Compressibility of the Alkali Halides. By J. C. Slater. Pp. 135-150. 50 cents. Vol. 61, No. 6: Contributions to Mineralogy from the Department of Mineralogy and Petrography, Harvard University. 12: Catalogue of the Collection of Meteorites in the Mineralogical Museum of Harvard University. By Charles Palache. Pp. 151-159. 25 cents. Vol. 61, No. 7: A Mathematical Study of Crystal Symmetry. By Austin F. Rogers. Pp. 161-203. 75 cents. (Boston, Mass.)

U.S. Department of Agriculture. Farmers' Bulletin No. 1484: The Clover Leaf-Weevil and its Control. By W. H. Larrimer. Pp. ii+6. (Washington, D.C.: Government Printing Office.) 5 cents.

Uganda Protectorate. Annual Report of the Geological Survey Department for the Year ended 31st December 1925. Pp. 30. (Entebbe.)

Loughborough College, Leicestershire. Calendar, Session 1926-27. Pp. xiv+228+67 plates. (Loughborough.) 2s. 6d. net.

Diary of Societies.

SATURDAY, AUGUST 14.

MINING INSTITUTE OF SCOTLAND (at Glasgow).

WEDNESDAY, AUGUST 18.

CORRELATION OF SCIENCE SOCIETY (at Royal Botanic Society of London), at 3.—Conference on Partial Impact and Whirling Coalescence.

SATURDAY, AUGUST 21.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Annual Meeting) (at Newcastle-upon-Tyne), at 2.30.

CONGRESSES.

AUGUST 27 AND 28.

IRON AND STEEL INSTITUTE (Autumn Meeting) (at Stockholm).—F. Adcock: The Effect of Nitrogen on Chromium and some Iron Chromium Alloys (Alloys of Iron Research, Part IV.).—J. H. Andrew and H. A. Dickie: A Physical Investigation into the Cause of Temper Brittleness.—Prof. C. Benedicks, H. Backstrom, and P. Sederholm: Anomalies in Heat Conduction, with some Determinations of Thermal Conductivity in Iron and Carbon Steels. Prof. C. Benedicks and R. Sundberg: Electrochemical Potentials of Carbon and Chromium Steels.—G. F. Comstock: The Treatment of Steel with Ferro Carbon-Titanium. G. A. Hankins, D. Hanson, and Miss G. W. Ford: The Mechanical Properties of Four Heat-Treated Spring Steels.—Prof. K. Honda: Is the Direct Change from Austenite to Troostite Possible?—A. Johansson and R. Von Seth: The Carburisation and Decarburisation of Iron and Some Investigations on the Surface Decarburisation of Steel.—A. Johansson and A. Wahlberg: The Development of the Swedish Iron and Steel Industry during the last thirty years.—E. Kinander: Notes on Jernkontoret.—A. Lundgren: The Testing of Hardened Steel.—W. Petersson: Notes on the Development of the Swedish Mining Industry during the last twenty-five years.—G. Phragmen: The Constitution of the Iron-Silicon Alloys.

AUGUST 29 TO SEPTEMBER 1.

SOCIÉTÉ HELVÉTIQUE DES SCIENCES NATURELLES (at Fribourg).—In Sections devoted to Mathematics, Physics, Geophysics, Meteorology and Astronomy, Chemistry, Geology, Mineralogy and Petrography, General Botany, Special Botany and Geographical Botany, Zoology, Entomology, Anthropology and Ethnology, Palæontology, Medical Biology, History of Medicine and Natural Science.

AUGUST 31 TO SEPTEMBER 8.

WORLD POWER CONFERENCE (at Basle), Technical Programme of Sectional Meeting:

Utilisation of Water Power, and Inland Navigation.
Exchange of Electrical Energy between Countries.
The Economic Relation between Electrical Energy Produced Hydraulically and Electrical Energy Produced Thermally: Conditions under which the two systems can work together with advantage.
Electricity in Agriculture.
Railway Electrification.

SEPTEMBER 1 TO 4.

INSTITUTE OF METALS (Autumn Meeting) (at Liege) (September 1, at 8.—Dr. W. Rosenhain: Ancient Industries and Modern Metallurgy) (Autumn Lecture).—Dr. C. J. Smithells, H. P. Rooksby, and W. R. Pitkin: The Deformation of Tungsten Crystals.—Prof. K. Honda: A Comparison of Static and Dynamic Tensile and Notched-Bar Tests.—C. H. M. Jenkins: The Constitution and the Physical Properties of the Alloys of Cadmium and Zinc.—H. J. Gough, S. J. Wright, and Dr. D. Hanson: Some Further Experiments on the Behaviour of Single Crystals of Aluminium under Reversed Torsional Stresses.—B. Ôtani: Silumin and its Structure.—G. B. Phillips: The Primitive Copper Industry of America. Part II.—Kathleen E. Bingham: The Constitution and Age-Hardening of Some Ternary and Quaternary Alloys of Aluminium containing Nickel.—Dr. A. G. C. Gwyer and H. W. L. Phillips: The Constitution and Structure of the Commercial Aluminium-Silicon Alloys. With an Appendix upon The Properties of the Modified Aluminium-Silicon Alloys, by Dr. D. Stockdale and I. Wilkinson.—J. D. Grogan: Some Mechanical Properties of Silicon-Aluminium Alloys.—Dr. C. S. Smith and Prof. C. R. Hayward: The Action of Hydrogen on Hot Solid Copper.—Capt. F. R. Barton: The Development of the Use of Nickel in Coinage.—A. Pinkerton and W. H. Tait: Season-Cracking in Arsenical Copper Tubes.—Prof. P. Chevenard: Thermal Anomalies of Certain Solid Solutions.—W. T. Cook and W. R. D. Jones: Preliminary Experiments on the Copper-Magnesium Alloys.—F. W. Rowe: Bronze Worm Gear Blanks produced by Centrifugal Casting.—L. Boscheron: An Account of the Non-Ferrous Metals Industry in the Liége District.

SATURDAY, AUGUST 21, 1926.

CONTENTS.

Educational Training for Overseas Life.

NOT the least significant feature of the third report of the Committee appointed by the British Association to consider the Educational Training of Boys and Girls for Overseas Life, presented at the Oxford meeting, is the emphasis which is laid upon the social importance of agricultural and other practical studies. The Committee rightly states that the intellectual and cultural aspects of practical studies are too often overlooked or regarded with contempt by educational authorities who fail to appreciate the clearer vision which accompanies contact with reality and the greater interest which practical work, even if vocational in aim, arouses in the pupils themselves. As Mr. H. W. Cousins aptly remarked, in the discussion on the report, the purpose of education should be to create an interest in doing things, not in merely talking about them, a sentiment which was warmly applauded by H.R.H. the Prince of Wales, who was present.

While it is true that the work of Prof. Nunn and other educationists is gradually modifying the attitude of teachers in schools towards practical work—not merely work in a chemical or physical laboratory—it is equally true that their efforts to combat 'education by book' are hampered and discouraged by most examining bodies. The capacity of the 'bookish' pupil is easier to assess than that of the pupil whose main interest lies in acquiring understanding of, and the capacity of participating in, the activities of his particular environment. A board of examiners sitting in one of the great centres of learning, however well intentioned, must find it exceedingly difficult catering for the needs of pupils in various environments, whose education is 'practical' and suited to the special environment, but of which the examiners themselves can know very little. Their difficulties would be increased if education authorities in those of our overseas territories, which are connected for examination purposes with English universities, desired to develop a schools curriculum based on the special needs of the countries they serve.

The point might well have been made by the Committee on Overseas Training that the education of boys and girls in our Dominions, Dependencies, and Crown Colonies is more 'bookish' and less adapted to make them capable of 'deliberate adjustment to their environment'—after all, the true purpose of education—than that which is given at home. There, those who are charged with the responsibility for the evolution of a system of education have generally accepted unreservedly the system evolved to suit a very different environment. Instead of basing their system upon the needs of the many, they have subordinated it to

the English examination system in order to cater for the needs of the very small number of pupils who may proceed to England to pursue their further studies. Certain education authorities in Ceylon, it is stated, send to a biological station in England for specimens of British marine and other material prescribed for study by one of our examining bodies. It would seem obviously the better course for the examining body to prescribe for study some of the specimens which abound in Ceylon.

Kenya Colony, the only East African territory where public provision is made for the education of European children, is an abject slave to the tyranny of the London Matriculation and the Oxford and Cambridge Local (so called) examinations. Most of the children educated in the State schools in Kenya will certainly never leave East Africa for a further course of study in Great Britain. The environment to which they have to adjust themselves is essentially agricultural; an environment which demands an understanding of the black races, and a sound knowledge of the elementary principles of social and personal hygiene, and human, animal, and plant diseases; in other words, an education where the bias should be agricultural and otherwise practical, where work in the field and workshop and laboratory should be the basis of the instruction in science and elementary anthropology the basis of the 'humanistic' studies. Nothing of the kind has been attempted. The syllabus of instruction is that prescribed for the 'literary' side of the English examinations; there are no workshops, there are no laboratories, there is no provision for practical work in the field. Where 'science' instruction is given at all it is 'out of the text-book.' What knowledge the children have of the native races is acquired in a school of experience which is calculated to breed contempt for them, and sow seeds of racial antagonism. Both the blacks who come within the sphere of influence of the State schools, and the Indian children, are being better educated than the children of the Europeans.

The most obvious commentary upon the type of instruction given in schools in Australia is the disproportionate size of its cities. Appeals for immigrants are made to compensate for the flight of colonial-born agriculturists from the land to the social amenities of towns, and the reluctance of Australia's urban unemployed to transfer to the land. Much the same problem faces all our self-governing dominions. This problem of education is of world-wide significance and of especial importance to the British nation, which bears a grave burden of responsibility for the development of so great a proportion of the world's natural resources and of the backward races. It is sufficiently important to command much of the attention of the statesmen of the Empire who will shortly be gathered together for another Imperial Conference. Education is not a subject remote in its bearings upon Imperial policy; it lies at the root of it. Upon the type of instruction which is given in our educational institutions at home will depend largely the character and outlook of the administrators of the scientific and technical experts in tropical possessions, and of the settlers in British dominions. Administrators could be produced whose training and educational achievements would be a guarantee that they would combine understanding of the problems inherent in the development of the natural resources of a country and the development of the soul of a people; and the scientific and technical services could be manned by those who combined knowledge of their craft with understanding of primitive crafts and a realisation of the social and political significance of the introduction of European ideas and processes among backward peoples.

If the needs of the better instructed elements among the Britons who proceed overseas are such as to demand considerable changes in the education which is given them as a preliminary training, the needs of the secondary school boys and girls destined for overseas work is greater. Whether they go to the tropics, where they must perforce have intimate contact with backward peoples, or to the self-governing dominions, there are certain obstacles which 'personality' alone cannot overcome, but 'character' based upon knowledge, capacity, and grit can. Prejudice against a newcomer wishing to introduce new methods into production is the commonest of diseases. But prejudice is not best overcome by pandering to the 'oldest inhabitants' fixed notions of what is right, but by proving the greater efficiency of the new. It is doubtless true, as Mr. Ormsby-Gore said at Oxford, that overseas farmers prefer to deal with 'raw' rather than instructed new settlers, that they prefer a man who has had no agricultural training in England to the man who has, because the methods overseas are vastly different from those at home. It does not follow, however, that the overseas man on the spot is sound in his prejudices. His methods may be thoroughly unsound. The home-trained man's methods, even applied in a new country, may be thoroughly sound in principle.

The most important aspect of the problem of land-settlement is the outlook of the settlers upon their work. Not the least significant feature of the flight from the land is the material sacrifices which those who are forsaking agriculture are prepared to make for the greater amenities of town life. The only apparent remedy lies in an education system which will bring greater contentment to the comparatively

isolated land worker. It is not easy to prescribe the exact form which this remedy must take, but it is fairly clear that it must depend upon the quickening interest of the workers in their vocation. No greater harm could be done to the cause of agriculture than by ceaseless reiteration of the material benefits arising from its pursuit. There is a limit to credulity and gullibility.

What is wanted is for the Imperial Conference to take an intelligent interest in this problem. It is more vital than tariffs; without even a partial solution much of the work of the politician and financier and trader will be wasted. An Imperial Education Committee is of more importance even than an Empire Marketing Board. It will not suffice to refer the problem of education to a committee of expert educationists; the responsible leaders among the statesmen of the various dominions and Crown colonies must be prepared to consider the whole problem with the experts and to make their own contribution to the discussions. They must let the educationists know what they hope from them: they must be prepared to fight for the necessary changes in educational policy in the countries for which they are responsible. Above all, they must assist the true educationist to rid himself of the examination blight. They must encourage a spirit of experimentation in educational method and realise that a stereotyped Prussian system of instruction, towards which we have been retrogressing while even the Prussians themselves have commenced to react against it, will kill the soul of any people.

The eminent persons who spoke at Oxford, ostensibly in support of the recommendations of the Overseas Training Committee, cannot be said to have laboured the essential features of the report. They gave the impression that a social veneer was a greater attribute to a man than social qualities. It cannot be overemphasised that the latter depend upon knowledge based upon a sound education system. According to one speaker, it was more important for a man proceeding overseas to have gone to the right type of school than it was for him to have acquired the right kind of knowledge, based upon an intensive technical training. It is a pity it is not more generally recognised that this curious snobbery is responsible for more of the defects in our administration system and our comparative failures in Imperial affairs than any other factor.

One other point which emerged in the discussion is of some interest, and this is the one which was raised by Mr. Ormsby-Gore in connexion with the staffing of the education and scientific services in the Crown Colonies. He stated that the Crown Colonies are in the greatest need of expert educationists and first-class scientific advisers. At present the demand exceeds the supply and it is impossible to fill many of the vacancies which existed. This he contrasted with the ease with which the late German administration in East Africa had built up its wonderful research institutions. It can only be hoped that this was not special pleading on the part of Mr. Ormsby-Gore to justify the chronic neglect of the British administration of once world famous institutions. The fact is that it is only within the last two years that the slightest appreciation has been displayed, either by the local governments of East Africa or by the Colonial Office, of the obvious fact that upon the education and scientific services the whole future of East Africa will depend. There would be no difficulty in obtaining the personnel for either of the services if the proper inducements were offered, and if the Colonial Office and the other governments would realise that it is not merely material inducements which will make the East African services attractive: conditions of service are just as important as salary, and the Colonial Office should realise that it is sometimes possible to offer a large salary without attracting candidates, because the acceptance of the post would rob the man appointed of all title to the respect of his fellows.

Indian Witchcraft and Primitive Forms of Belief.

Religion and Folklore of Northern India. By William Crooke. Prepared for the Press by R. E. Enthoven. Pp. iv. + 471. (London: Oxford University Press, 1926.) 21*s*. net.

WHEN the history of the study of 'things Indian' is written, the name of the late William Crooke will rank high. His erudition was vast, and his range of reading immense, while his sanity of outlook and grasp of matters of fact guided him among the many pitfalls which have beset the paths of theory in Indian ethnology. It was these qualities which made him a particularly safe guide to the student and accounted largely for the high repute of the pioneer work in his little book "An Introduction to the Popular Religion and Folklore of Northern India," first published in 1894. It was reissued in 1896, and is now published posthumously in a third edition, but entirely rewritten in the light of further information.

It is scarcely necessary to stress the importance of Crooke's work in the study of the primitive religions of India. His contact with the village population in the course of his duties as an official of the Civil Service led him to the study of their beliefs and ritual. These he found represented a type very different from those of the priestly class and those described in the sacred books of the Brahmans. His investigations ranged

over the whole of northern India to the Nerbada River, and took in the population of the west coast and the Deccan. This area had been overrun by many waves of foreign incursions flowing over an indigenous population. Its inhabitants included primitive Mongoloids, represented by the tribes of the Assam frontier and the Kols and allied tribes, Dravidians such as the Gonds and Oraons, and in the Punjab, Indo-Aryans, Persians, Greeks, Sakas, Indo-Parthians, Huns, and Mongols.

The study of this medley of races revealed that the superficial uniformity of the widely adopted Hinduism embraced a variety of beliefs ranging from primitive animism to the worship of deities of the orthodox pantheon. In fact, Crooke's researches showed that while some conformed to Hinduism, owing to the rise in social status which followed the adoption of Brahmanism, and yet retained the cults of their tribal deities, others regularly resorted to the village, caste, or tribal godling in times of crisis, drought, famine, or pestilence. On the other hand, there went on *pari passu* a process of adoption of the godlings of the animistic peoples into the Hindu pantheon. Of such were the benign Devi, traced back to one of the manifestations of Dharti, the earth mother, Kali, a deified tigress, and on a lower scale not yet fully of orthodox rank, Hanuman the ape and Ganesa the rat. These latter are the Dvārāpalas, 'doorkeepers,' of the temple of the greater gods. The story of these local deities and of their development out of the strictly local cult into a more widely, or even generally, recognised object of worship is a pregnant chapter in the history of religion.

It is not without significance, and it is at the same time interesting to note, that among the many heroes who are objects of a cult appear the names of several Englishmen and an Englishwoman, whose tombs are treated with special reverence and to whose spirits offerings are made. The ghost of Capt. Cole, killed in 1804, is propitiated with offerings of wine and cigars; another, the spirit of a bibulous official, with beer and whisky; while the tomb of Col. W. Wallace of Sirur in Poona is worshipped on Thursdays and Sundays "in fulfilment of vows made for the cure of barrenness."

It would be difficult to single out any one topic as especially worthy of mention where so much is of interest and importance, whether in relation to the more primitive forms of belief among the Indian peoples themselves, or as affording material for comparative study. There is, however, one line of inquiry for which the religious, social, and racial conditions make northern India an especially promising field. Dr. Crooke's last chapter deals with the black art and witchcraft—a subject which offers occasion for many interesting questions. What, for example, is the relation between practitioners of white and black magic, and at what stage of development do they become differentiated? The Shaman, or medicine man, who may, and indeed often does, practise both forms of magic, develops on one hand into the orthodox magician or priest whose function is normally exercised to the advantage of his social group and its members, on the other into the witch whose action is malevolent and anti-social. The priest may still practise black magic, as do some Brahmans, with impunity. The Jackdaw of Rheims was cursed 'by book and by bell' as effectively as if he had been the victim of the blackest magic. The witch is destroyed or cast out.

The term 'witchcraft' is constantly used loosely in describing magical practices of primitive peoples, but it should imply more than the occasional use by any individual of magical practices for malevolent purposes. The witch of northern India as described by Dr. Crooke is one who performs harmful acts through the control of evil spirits. In European witchcraft, while the basis of the belief was purely magical, as can be seen even in the Bull of Innocent VIII., where the witch was said to blast crops, harm cattle, and bring disease and death to human beings—just as the Indian witch—yet the essential element in the legal and theological definition of a witch was the fact that she had entered into a compact with the devil from whom her power was derived. This no doubt goes back to the practice of the early Christian Church, which regarded backsliders into paganism as devil worshippers, and witchcraft was closely connected with heresy. But it is also significant that the Templars, who were reputed to have brought their alleged magical practices from the East, were accused of trafficking with and controlling evil spirits.

Indian witchcraft affords some curious and interesting parallels to the European belief. The witch is marked out by her appearance. Dhanwārs in the Central Provinces, for example, detect a witch by the sunken and gloomy appearance of the eye. Ovid mentions a double pupil as characterising a witch; in Wales she can be detected by the inversion of the image reflected in the eye. Unlike the European witch, almost invariably a hag, the Indian witch is beautiful. The witch acquires her art by a course of instruction. Among the Santals the novice, with a lamp in her hand and a broom tied to her waist—note the appearance of the broom—is taken to be married to one of the Bongas or spirits. The parallelism of the European methods of initiation is not exact but is sufficiently close. Again, Indian witches possess familiars, a cat or a tiger, and they themselves take on animal form. The use of a waxen image to harm an enemy, a practice which goes back to early Babylonia and Egypt, and is familiar in European witchcraft, is also noted. One of

the most remarkable feats of the Indian witch in this connexion is the 'abstraction of and eating a man's liver,' of course without his knowledge until he realises that he has been bewitched and in what manner. European witches sometimes 'extracted the heart' in much the same way. Finally, in both Europe and India a witch is detected by casting her into water to see if she will sink or float.

We may conclude with a much travelled story. Lona, an Indian witch noted in legend, performed an incantation for a young man over a hair supposed to belong to the object of his affections. Unfortunately for him, he had been deceived by a slave and the hair had been taken from a sieve which burst into the room immediately the magical rite had been performed. The same story is told of John Fian, the leader of the witches who conspired against James I.; but in his case the hair was that of a heifer, which incontinently pursued him, to his great embarrassment and confusion.

Storm and Stress.

(1) *Pleasure and Pain: a Theory of the Energic Foundation of Feeling.* By Paul Bousfield. Pp. x+114. (London: Kegan Paul and Co., Ltd.; New York: E. P. Dutton and Co., 1926.) 4s. 6d. net.

(2) *The Adolescent Girl: a Book for Parents and Teachers.* By Dr. Winifred Richmond. Pp. xv+212. (New York: The Macmillan Co., 1925.) 5s. net.

(3) *The Gang Age: a Study of the Preadolescent Boy and his Recreational Needs.* By Dr. Paul Hanly Furfey. Pp. xiv+189. (New York: The Macmillan Co., 1926.) 8s. 6d. net.

OF recent years, emotion as the driving and guiding principle, which shapes our lives and determines our behaviour, has occupied the attention of psychologists to a greater and greater extent. More particularly have they attempted to study from a scientific aspect that period of difficulty through which every boy and girl must pass as the simpler adjustments of the home give place to the wider emotional relationships of society. To the individual adolescent the period is still as stormy as it was to Goethe, and the adult is only groping his way to an understanding which will enable him to help. The question of what emotion is remains unsettled, and while all authorities regard the affective reactions of pleasure and pain as important constituents, they are by no means unanimous as to their exact relation to appetite, instinct, and emotion.

(1) Dr. Bousfield has approached the problem of pleasure and pain by attempting to explain the apparent paradox of the pleasure of enduring pain. First of all, he maintains that the fundamental disposition in all animals is a reaction to stimuli in such a way that tension will be reduced. Even such instincts as self-preservation and race preservation are not innately given, but the result of social influences in each generation. He demonstrates the rise and fall of tension by means of diagrams, and points out that pleasure does not exactly correspond to the fall of tension, since the maximum of pleasure depends rather on the rate than on the extent of the fall.

During life, tension is never completely relaxed, since there is always a degree of postural tone in all tissues. There may be no conscious awareness of this, but there may be an unconscious desire to retreat from this permanent tension (the death instinct of Freud).

With the advent of prospective imagination, pleasure may be induced by the prospect of relief of tension, and as a result a temporary slight diminution may ensue, although it still persists at a relatively high level. This may prolong and intensify pleasure, and with the alternations of prospective relief and actual imposition of tension the subject may even experience pleasure in painful situations.

(2) Without going into the abstruse question of the derivation of emotional reactions, Dr. Richmond, in "The Adolescent Girl," deals with the difficulty of adjustment of these reactions to the demands of society. A brief survey is undertaken of primitive cults and ceremonies in relation to the change in the girl's life, and a description is given of the physical and mental alterations incident to puberty. She points out that neurosis and delinquency easily arise out of the conflicts of this time, and that it is a matter of some wonder that the 'normal' girl does emerge from the welter of conflicting subjective impulses and objective influences. No attempt is made to discuss the root causes of troubles which arise, but sound advice is given to parents and teachers as to the upbringing of the adolescent, so that they may be alive to the possibilities of disaster and recognise the early signs of trouble, to the end that skilled assistance may be sought before it is too late.

(3) Similarly, Dr. Furfey deals with the preadolescent boy of ten to fourteen years, a period which he designates the gang age, since the child ceases to be individual and discursive in his interests, but concentrates his whole attention on the work of his activities in play. Dr. Furfey regards this phase as one of paramount importance in the normal development of the boy, and therefore one which ought to be supervised most carefully and skilfully. He quotes several case records to illustrate derivations from the normal at this time, and gives good advice as to the proper management of the child at this period of life. As he points out, the average child spends much more time in recreational

than in intellectual activities, and educationists may have neglected the former too much in favour of the latter. It may be advisable for the boy to be allowed a certain freedom to follow his individual bent in recreations, but during the gang age, when individualism is in abeyance, guidance is both wholesome and necessary. R. G. G.

Root Habits and Growth.

Root Development of Field Crops. By Prof. John E. Weaver. (McGraw-Hill Publications in the Agricultural and Botanical Sciences.) Pp. xii+291. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1926.) 15*s*. net.

FROM time immemorial observations and notes have been made on the aerial growth of crop plants under varying conditions of cultivation, and an extensive literature has arisen thereon. On the other hand, the subterranean growth has received little attention, and accurate information as to the relation between shoot and root growth is remarkably meagre. During recent years a few investigations have attempted to remedy this, the most notable contributions being those of Howard in India, and Prof. Weaver and other workers in America. The mechanical difficulties of root investigations *in situ* are such that satisfactory work can only be done where the soil and subsoil are of such a nature as to permit excavation without undue expenditure of time and labour and excessive danger of breaking the roots while their course is being traced. During the last twelve years Prof. Weaver has extensively developed the technique of root excavation by means of systems of trenches, and the volume under review aims at presenting the main American results which have been set forth in detail elsewhere.

The preliminary chapters deal briefly with soil characteristics as correlated with plant growth, and an excellent epitome is given of root structure and development, an elementary aspect of matters which is seldom lucidly explained. From the general point of view, one of the most important sections is that dealing with root habits in relation to crop production. Root growth is often extremely rapid, being so much as ½ inch per day in grasses and 2-2½ inches per day in maize, the total root development being extraordinarily great as compared with the top growth, especially in the early stages. The ratio between the dry weight of shoot and root is often used as a standard of comparison between different plants, but scarcely represents the truth. The real measure of the functioning of a root lies in its absorbing surface, and a very finely branched root has a much greater surface and is far more active in working than a thick, heavy root with few branches.

Weaver opposes the idea, often stated in standard text-books, that crop plants in general are shallow-rooted and that only the top 6 or 8 inches of soil are suitable for growth. A consideration of the conditions under which root investigations have been carried out in various places, however, would lead one to suppose that the nature of the subsoil must play a most important part with regard to root penetration and the absorption of water and nutrients. In deep, easily worked soils and subsoils, such as apparently have been investigated in Nebraska, most crops are able to penetrate well, to develop an extensive root system, and so to commandeer larger stores of deep-seated water and food supplies. In other areas, where a comparatively shallow soil overlies a heavy intractable subsoil, many crops are unable to penetrate far and so gain a character for being shallow-rooted, while a few are able to go rather deeper in spite of the subsoil, and are therefore considered to be inherently deep-rooted. Further work under varying soil conditions will be needed to clear up many of the debatable points raised in the present volume. In humid regions the unproductiveness of the subsoil is recognised, whereas in arid regions this is not so. Greater root development occurs where plant food is plentiful, and this has an important relation to agricultural practice, influencing the depths of manuring, the type of fertiliser used, and the depth of ploughing, according to the crop grown. Tillage methods, as such, may not influence root habit directly, the changes in growth induced by tillering being really in response to differences brought about in the physical and chemical conditions of the soil and subsoil. Varying rooting habits may be turned to commercial advantage, for by growing mixed crops, which tap different soil layers for their water and nutrients, an increased total yield may be obtained. The reason that some weeds are more detrimental to certain crops than others may be because they absorb water and nutrients from the same level as the cultivated plants.

The root habits of native plants afford a useful indication as to soil conditions, and give some guide as to the crop plants that are most likely to succeed. This is specially the case in areas where the water content of the soil is the chief limiting factor to growth, the prevalence of scanty, short vegetation indicating conditions that are unfavourable or even hazardous for crop production. The detailed investigations on the root growth of individual crops not only bring out clearly the difference between one crop and another, but also the variation induced by different methods of cultivation, such as by spring and autumn sowing in wheat. In barley and sugar-beet, particularly, root penetration is much affected by the type of subsoil, as over a dry subsoil a mass of roots is formed in the

surface soil, whereas deep penetration is achieved under other conditions.

An outstanding feature of these investigations is the care and accuracy with which the illustrations have been prepared. Photographs and ordinary sketches proved unsatisfactory in field work, and a method has been evolved whereby each root, as it is traced, is mapped into position on a vertical scale, horizontal maps also being made for certain plants, such as pumpkins, maize or cacti, in which the roots spread widely. A description is given of the method of excavation which has proved so remarkably successful on the type of soil dealt with, and a good bibliography rounds off a volume which fills a definite gap in the annals of agricultural botany and suggests many starting-points for further investigations. W. E. B.

Our Bookshelf.

Animals of Land and Sea. By Austin H. Clark. (Library of Modern Sciences.) Pp. xxxiv+276. (New York: D. Van Nostrand Co.; London: Chapman and Hall, Ltd., 1925.) 15*s.* net.

THIS is a good book, but misses being a very good book. It is full of interesting facts, but they are not always well arranged. Mr. Clark's knowledge is extensive and often peculiar, but he has not digested it well: too many of the chapters read like the outpourings of a notebook, not free from unnecessary repetition. Finally, the numerous figures are so dispersed through the book that they can scarcely be said to illustrate the text: thus, opening at random, one finds thirty-four drawings of "biting and parasitic flies, and some maggots and pupae of flies" facing a page that deals with flying-fish. Biting flies were discussed some hundred pages earlier, but there was in the text no reference to these figures; for any further explanation of them one must hark back to the list of text-figures. Possibly the publishers are responsible for this lack of co-operation, for it is a too common fault in popular books written to order. None the less, the authors are to blame, and it is surprising to find a man of Mr. Clark's vigorous personality permitting this indignity.

Towards the end of the book the method improves. The chapter on animal flight is on the whole excellent: it works out certain ideas and subordinates the facts and observations—many of them original—to the main arguments. Yet even here some of the cargo might have been jettisoned with advantage. The chapters on "The Basis of Life in the Sea," "The Intermediate Foods of the Sea," and "The Ocean and the Land"—a contrast between their inhabitants—also puts the facts in a novel light that may reveal points of interest even to those who know them already, and may suggest fresh lines of inquiry. We are acquainted, in a sort of a way, with hundreds of facts that we do not realise; we must fit them into a scheme and see their mutual relations before our acquaintanceship matures into knowledge. It is because Mr. Clark has acted increasingly on this principle that his later chapters are more effective than his earlier. The penultimate chapter—"Life's Borderlands"—which brings together the extremes of temperature, pressure, and the like, under which life can exist, is remarkably interesting.

To write a book of this kind in such a way as to attract a large public is no easy task. The entire and not wholly inexplicable ignorance that most otherwise well-educated people display regarding their fellow-creatures, especially the inhabitants of the waters, presents an almost insuperable obstacle to the writer or speaker who wishes to interest the ordinary man in these aspects of life. We hope Mr. Clark will be found to have succeeded, for his aim, prudently kept in the background, is one with which readers of NATURE will sympathise.

Le Relief de la terre: ses origines, ses lois, son évolution; principes nouveaux de géographie physique. Par Paul Soulier. Pp. x+432+3 planches. (Paris: Félix Alcan, 1925.) 30 francs.

THIS interesting, if not very convincing book may be described as a fugue with the hypsographic curve as its principal theme; a hypothetical structural curve derived from it as the answering subject; the geochemical cycle of water, often repeated, as the counter subject; and a final *stretto* in which these and many related episodes are worked up into an all-embracing explanation of terrestrial relief. The author supposes the effects of denudation and deposition never to have taken place, and shows that the hypsographic curve is then transformed into a simple structural curve. He deduces from this that the structural relief of the earth's surface follows the statistical laws of chance, and therefore, ignoring the implications of isostasy, he rejects Wegener's well-known deduction from the hypsographic curve. Erosion has accentuated the upper concavity of the 'original' curve, and the continental plains and shelves have developed on the middle regions of the structural surface by the accumulation of sediments.

A summary of various theories of mountain building is given and all the existing hypotheses are rejected as inadequate. The author then suggests that water passes down through the surface rocks to an underlying "active orogenic zone," where it promotes aquo-igneous fusion and a general expansion of the materials there present by a process of hydration. The activities of the orogenic zone are made responsible for all the puzzling phenomena of vulcanism, compression, and tension, and for the surface relief of the moon and of Mars as well as of that of the earth. The gradual lowering of the surface of the oceans, due partly to the intensification of relief and partly to the internal absorption of water, leads to the conception of islands developing into continents by coalescence and the uplifting of peripheral mountain systems.

M. Soulier's theory of the earth is not likely to win acceptance, for it runs counter to the modern trend of geophysics. In particular it ignores the effects of radioactivity, and introduces instead a hydrothermal process that seems quite incompetent to produce the results ascribed to it. Nevertheless, the book is original in method and stimulating in thought, and it certainly deserves to be read by those interested in the evolution of the earth's surface features.

Geographie der Moose. Von Prof. Dr. Th. Herzog. Pp. xi+439+8 Tafeln. (Jena: Gustav Fischer, 1926.) 27 gold marks.

While many writers have published works on the anatomy and taxonomy of mosses, Prof. Th. Herzog has struck out on a new line in his recently published volume and given an account of their geographical distribution together with that of the Hepaticæ. He has done for the mosses what Dr. H. Christ did for the ferns in his "Geographie der Farne." Unlike the older writers on plant distribution, he does not give his results in statistical tables but follows the examples of Prof. E. Warming in his "Oecology of Plants," and in the first 74 pages gives an interesting account of the factors, both internal and external, which influence the choice of a habitat, and distinguishes between distribution by spores and by asexual vegetative means. By this method it becomes easy to realise why some species have a wide range while others are confined to a restricted area.

The section dealing with the substratum upon which mosses grow is of special interest and contains lists of species which are confined to either acid, neutral or basic rocks, or to two of them, or (like *Brachythecium rutabulum*) will thrive equally well on any of the three. The epiphytic species are also dealt with in this section. This is followed by 136 pages, in which the distribution of the various families is discussed in detail.

The third section deals in a similar way with the geographical regions and gives numerous examples of the species characteristic of them. A few maps are inserted; that on p. 214 shows clearly the parallelism in distribution in widely separated areas of Gigaspermum and the genus Callitris belonging to the Cupressineæ, namely, north-west Africa, South Africa, and Australia. This Herzog terms "Disjunktionen." The book, which concludes with a classified bibliography and two indexes, one geographical, the other of genera and species, is illustrated with 151 text figures and 8 plates, Fig. 70 showing the various forms of thallus which occur in Aneura. The work should form a stimulating contribution to the literature of bryology.

C. H. W.

The Relation of Nature to Man in Aboriginal America. By Prof. Clark Wissler. Pp. xx+248. (New York and London: Oxford University Press, 1926.) 16*s.* net.

In the text of this volume Dr. Clark Wissler follows closely a course of lectures at the Wagner Free Institute of Science, Philadelphia, which he delivered under the Richard Westbrook Free Lectureship Foundation. It is an admirably lucid exposition of the method of attacking anthropological problems by the study of distribution, and as such it is deserving of careful attention apart from the application of that method to the specific problems of aboriginal America to which the earlier chapters lead. The subjects reviewed are samples of the material culture, segregated distribution, social traits and somatic traits, and finally distribution form and its meaning.

The method is one of special importance in the study of American culture, where indeed there is a peculiarly favourable field for its employment. Its application to the somatic problem is especially instructive in view of the conclusion generally held by American anthropologists as to the homogeneity of the aboriginal population, notwithstanding differences such as that found in head-form. On the ecological side of the inquiry, Dr. Wissler's conclusion is that there is good ground for suspecting that the principle of concentric distribution is an ecological phenomenon universal to the more specialised form of plant and animal life, including man. Dr. Wissler's book is a most valuable and stimulating contribution to the method of anthropological study, but why will he, in common with many other scientific writers, especially in the United States, treat the words *fauna* and *flora* as if they were feminine singular nouns and endow them with an entirely superfluous plural in *æ*?

The Pedigree of the Human Race. By Prof. Harris Hawthorne Wilder. Pp. xiv+368. (New York: Henry Holt and Co., 1926.) 3.25 dollars.

In spite of its title, Prof. Wilder's book refers to the races of mankind only in the last chapter. It is a compilation of a great deal of interesting information relating to the comparative anatomy of the Primates. But it scarcely fulfils the expectation the title suggests, for there is relatively little serious discussion of the pedigree. In a work dealing with man's ancestry, it is rather surprising to find no mention of Propliopithecus, perhaps the most interesting link in the chain, and an absence of reference to the leading works on the subject of the book.

The classification of the Primates is peculiar. The Tarsiidæ are included in the sub-order Anthropoidea. Though much might be urged in excuse of such a course, it can only create unnecessary confusion; and the student who critically studies the differential tables on pp. 25 and 26 will certainly be at a loss to discover why Tarsius is put under the heading Anthropoidea and not under Lemuroidea, seeing that it is cited as exceptional in respect of every feature enumerated and in most of these agrees with the Lemuroidea. Then again, alongside this ultra-modern treatment of Tarsius the antiquated idea with regard to Chiromys is retained. This specialised member of the Indrisinæ is removed from its own family and a special sub-order is made for its reception.

The book contains a large series of useful illustrations.

The Annual Register: a Review of Public Events at Home and Abroad for the Year 1925. Edited by Dr. M. Epstein. Pp. xiv+330+180. (London: Longmans, Green and Co., Ltd., 1926.) 30*s.* net.

This invaluable work of reference again gives a complete survey of the world's history during the past year in a small compass and a readable form. The customary arrangement is followed, of considerable sections devoted to Great Britain and the Empire, with smaller sections on other States. There are also surveys of the literature, science, art, drama and finance of the year, and a record of events. Appendices give the full text of the Locarno Treaties, the Irish Boundary Agreement, the Irish Bill 1925, and the Russo-Japanese Treaty. The work has now reached its 167th annual issue.

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Microstructure of Mercury.

IN the course of investigations on dental alloys and amalgams, which we have carried out at the National Physical Laboratory on behalf of the Dental Investigation Committee, Department of Scientific and Industrial Research, we have thought it necessary, for the full study of the constitution of the amalgams, to undertake their microscopic examination. As mercury, and the amalgams rich in mercury, must be completely solidified for this purpose, it has been necessary to devise means for the preparation, etching, and photo-micrography of specimens at very low temperatures. Most of the work has been done by means of a paste of carbon dioxide snow and acetone.

FIG. 1.—Microstructure of pure mercury. Magnification × 100.

Surfaces suitable for microscopic study have been prepared by allowing the metal to solidify in contact with glass, and such surfaces have been successfully etched by electrolysis in hydrochloric acid (sp. gr. 1·12 at 15° C.). It has also proved possible to polish the frozen specimens, but so far it has *not* been found possible to etch surfaces prepared in that way.

Special devices have been used for keeping the lenses of the microscope, etc., free from deposits of frost during examination and photography. Fig. 1 is a reproduction of a photograph showing the typical microstructure of solid mercury under a magnification of 100 diameters; we believe that this is the first time that such a structure has been recorded.

WALTER ROSENHAIN.
A. J. MURPHY.
The National Physical Laboratory,
Teddington, Middlesex,
July 30.

The Damping of Pendulous Jets.

IN a previous letter to NATURE (April 11, 1925, p. 530) the behaviour of liquid jets from a moving source was discussed theoretically, and supporting experimental data were presented. Dr. Julius Hartmann reviewed the subject in the issue of NATURE of June 6, 1925, p. 872, and arrived at confirmatory conclusions, though adopting a different mode of attack and manner of statement. Both of these communications treated the particles constituting the jet as though in free flight. The possibility of their being subject to viscous constraints while in flight was alluded to in the former paper, but Dr. Hartmann detected no such damping effects under his conditions of observation. Lately, Mr. Walter Thompson and I have examined the damping effect, and as the conclusions admit of concise statement they are presented herewith.

To recall the experimental conditions it may be stated that we have under consideration a jet of liquid issuing vertically downward, and that the container is subject to a linear, horizontal, oscillatory motion, and, in a particular case, a simple harmonic motion. The problem is the description of the horizontal motion of the jet at lower levels. It may be very simply shown that if the particles of the jet are acted upon during their fall by no force except gravity, and if the time of fall to the level considered is T, then the displacement of the jet from an arbitrary initial position will be $X = s + T\,ds/dt$. In this equation s represents the displacement of the container from its initial position at the instant of release of the particle observed. If damping forces, such as might be supplied by viscosity, are present, the particle, and hence the jet, will fall short of the displacement X defined above.

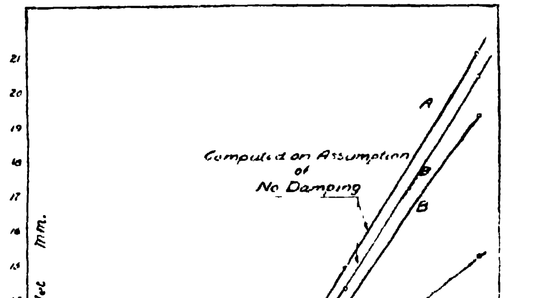

FIG. 1.—Effects of frequency and viscosity in diminishing the range of oscillation of jets. B curves are for a viscosity of 0·75 poises, A for 6·4 poises. Times of fall, about 0·75 seconds.

We experimented with six different oil mixtures, varying in viscosity from 0·75 to 6·45 poises, but otherwise physically similar. The specimen studied

was delivered from a cylindrical glass nozzle in the bottom of a container which executed horizontal simple harmonic motion of adjustable amplitude and period. Following the reasoning of the free-fall equation given above, one may readily compute the jet amplitudes to be expected, in the absence of damping, for any particular applied simple harmonic motion. Measuring jet amplitudes by a variety of methods, including photographic, we have compared actual with predicted values in several hundred cases.

It is learned that with low frequencies (one cycle per second or less) all of these liquids show amplitudes agreeing with the simple no-damping predictions, but that all of them, even the least viscous, show diminished amplitudes when the frequency is greater than two cycles per second. The more viscous the liquid the lower is the frequency at which this damping first appears. After its first appearance, damping always increases with increasing frequency, but at a slower rate with less viscous liquids. The variation of the damping threshold with viscosity is such as to indicate that only a liquid of zero viscosity would be entirely free from damping at high frequencies. Damping is very nearly independent of amplitude, though a slight increase with increasing amplitude may be observed.

The accompanying diagram (Fig. 1) illustrates the effects of both viscosity and frequency on the jet amplitudes.

These findings are of interest in connexion with the suggested use of recorded jet motions for the absolute measurement of seismic or other accelerations. The proposals are discussed in the communications to NATURE referred to above. It now appears impracticable to arrange a jet of any liquid which shall be sensibly undamped at frequencies so high as four cycles per second, and yet be viscous enough to fall unbroken for so long as half a second. A succession of falling solid spheres would seem to offer better opportunities for the development of the suggested method.

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Another Patagonian *Lusus Naturæ*.

RECENTLY I was interested to hear, from a friend, of the discovery in Patagonia of a representation of a human head sculptured in stone, and, at his request, the finder kindly allowed me to have it for examination.

I expected that it would be more or less of the same type as the rudely fashioned head[1] found by Prof. Franz Kuhn at Punta Arenas in the south of Chile, and now in the Natural History Museum of Buenos Aires; but when the object arrived it was at once evident that, although it bears a remarkable resemblance to a human head with definite features, it owes nothing of its form to human agency, and is, in fact, a strange freak of Nature

It was found, lying on the surface of the ground, in Tierra del Fuego, exactly where I do not know, and consists of a nodular piece of rock, weighing 1750 grams, and measuring 155 mm., 115 mm., and 75 mm. in its greatest length, breadth, and thickness respectively (Fig. 1). The surface is covered with a greyish patina, except where rubbed off on the projecting parts, which are of a dark, metallic grey colour. In appearance the stone resembles basalt, and is very probably an altered rhyolitic rock, but its nature cannot be accurately determined without submitting a section to examination under the petrological microscope. At one end there is an ancient fracture, and when the stone is set up on this

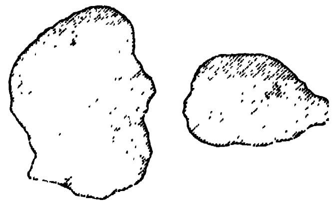

FIG. 1.—Vertical and horizontal profiles of the stone: scale ⅓.

as a base, it has the appearance of a bearded head, as may be seen from the photograph (Fig. 2). The fact of the fracture occurring at what seems to be the neck serves to strengthen the illusion, giving the impression that it is a head which has been broken from a statue

FIG. 2.—One side of the stone, from an untouched photograph: scale nearly ⅓.

South America has gained an unenviable notoriety as the source of periodical announcements of sensational palæontological and archæological discoveries, which, when investigated, generally prove to have no foundation in fact. The affair of Paso Ibáñez, in which a lump of sandstone was put forward as a fossil human skull of Tertiary age,[2] will yet be fresh in the memories of many, and the purpose of this note is to prevent any misconceptions as to the true nature of the object described, should it ever figure in the daily Press either as yet another 'proof' of the existence of Tertiary man in South America, or as a remarkable example of stone carving by the prehistoric inhabitants of Patagonia.

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Dwi-Manganese in Native Platinum.

CHEMICAL EXAMINATION.—Native platinum was long ago the subject of investigation and the search for elements not yet discovered. Kern, in the year 1877 (*Chem. News*, **36**, 1877, and **37**, 1878), A. Guyar

[1] This is figured by R. Hauthal, "Zwei bemerkenswerke Funde im südlichen Patagonien" (Congrès International des Américanistes. *Compte rendu* de la XXIe Session, deuxième partie, tenue à Goteborg en 1924, Fig. 6a, p. 518), Göteborg, 1925.

[2] The story of this extraordinary 'discovery' has been told by J. Imbelloni, "Nota sobre los supuestos descubrimientos del doctor J. G. Wolff en Patagonia" (*Revista de la Universidad de Buenos Aires*, vol. 51, pp. 39-51), Buenos Aires, 1923, and "L'uomo terziario fossile della Patagonia e la sua veridica istoria" (*Revista mensile del Touring Club Italiano, Le Vie d' Italia e dell' America Latina*), Milan, 1924

(*Chem. News*, **40**, 59, 1879), Kurtz (*Trans. Amer. Inst. Min. Eng.*, **33**, 347, 1903), A. French (*Chem. News*, **104**, 283, 1911) and many others claimed to have found new elements in native platinum. These 'discoveries,' however, have not been confirmed. In 1925 W Noddak, I. Tacke and O. Berg (*Die Naturwissenschaften*, No. 26, pp. 167-174, 1925) published a paper stating that they found in native platinum from the Gorablogodatski region, Ural, an element of atomic number 75. The quantity of the discovered substance was, however, so small (about 1 mgm.) that it was not possible to carry out conclusive experiments.

We have tested the native platinum systematically for the presence in it of dwi-manganese (No. 75). The platinum (mixed) was treated chemically, and the final products were investigated Röntgenographically. Dwi-manganese would have been easily detected if it were present in the native platinum in quantities pointed out by Dr. Noddak, or even 10 or 100 times less than that. As a matter of fact, the Röntgenographs obtained prove with certainty the absence of dwi-manganese in native platinum in a quantity exceeding 0 0003 per cent.

Our investigation thus settles the question about the presence of manganese analogues in native platinum in the negative sense. It is also very likely that eka-manganese, a closer analogue of manganese and a rarer element in the earth's crust, is not present in native platinum. Druce (*Chem. News*, **131**, 273, 1925) and Heyrovský (NATURE, November 28, 1925, p 782) seem to have chosen a more trustworthy way, assuming that dwi-manganese is associated with manganese and not with platinum.

O. ZVJAGINSTSEV.

The Platinum Institute,
Academy of Sciences of U.S.S.R.,
May 1.

RÖNTGENOGRAPHICAL EXAMINATION.—The investigation of the spectra was carried out either with Siegbahn's vacuum spectograph or with Muller's spectrograph with Hadding's tube In both cases the Röntgenographs were obtained with calcite crystal by the method of a fixed crystal. For the determination of the wave lengths of unknown lines, the lines $K\alpha_1Cu$, $K\beta_1Cu$ and $L\alpha_1W$ were chosen for reference lines (the substance under investigation mixed with about 5 per cent. tungsten was deposited on the anticathode of copper). The wave-lengths of the unknown lines were calculated from the following formula:

$$Ctg\ (\theta_2 - \theta_1) \quad \frac{a_{23}}{a_{13}} \; \frac{\sin(\theta_1 - \theta_3)}{\sin(\theta_2 - \theta_3)\sin(\theta_1 - \theta_2)} \quad Ctg\ (\theta_1 - \theta_2),$$

where θ_1, θ_2 and θ_3 denote the angles of deflexion for three given lines and a_{1x}, a_{2r}, a_{13} and a_{23} denote the mutual distances between the lines, measured with a comparator.

On Röntgenographs obtained with Müller's spectrograph, the doublet $K\alpha Cu$ was well resolved (the width of the lines was 0·06 mm. with equal breadth of the slit).

The accuracy of measurements of wave-lengths was 0·4 X.U., but no lines were found in the region where the K lines of the element 75 would be expected.

M. KORSUNSKI.
N. SELJAKOW.

Physico-Technical Röntgenological Institute,
Leningrad, May 1.

Kaufmann's Experiment and the Spinning Electron.

IN a paper in a recent number of the *Zeitschr. für Physik*, Wentzel has published a calculation of the X-ray screening constants on the basis of the spinning electron. He obtains values of the screening constants which are much larger than those experimentally determined, so raising a difficulty in the way of the acceptance of the spinning electron. Wentzel introduces into the calculations a force $1/c(\mu[vX])$ (μ = magnetic moment of spinning electron, v = velocity, X = electric field) the exact analogy of the force $e[vH]$ on a moving electric charge in a magnetic field.

It can readily be shown that, if this force is accepted as having a real existence, Kaufmann's experiment is conclusive against the spinning electron. In this experiment the moving electrons are subjected to the action of parallel electric and magnetic fields. The deflexions of the electrons due to the actions of the fields are thus perpendicular to one another, and in the case of the spinning electron there will be an additional deflexion due to the force $1/c(\mu[vX])$. This deflexion will be in the same plane as that due to the magnetic field. Then, taking the simple theory of the experiment (as given, for example, in Richardson's "Electron Theory of Matter"), we have for the deflexion in the plane parallel to the condenser plates

$$x_1 = (He + X\mu/c)z'(z' - z_1)$$

the $\pm$ sign being required because of the spatial quantisation of the spinning electron in the magnetic field.

Since now X ncH, in which n is a factor of the order 1/2 in Kaufmann's experiment, and $\mu = 2eh/4\pi m$ or two Bohr magnetons, it can be seen on inserting the values of the constants concerned that the quantity in the first bracket in the expression for the deflexion is approximately equal to $He(1 \pm \frac{1}{2})$. It will thus be seen that, instead of the trace on the photographic plate being a single arc of a parabola, this, for the case of the spinning electron, will consist of arcs of two parabolæ, the x co-ordinates of which are respectively approximately $\frac{1}{2}$ and $\frac{3}{2}$ of those of the arc obtained with the non-spinning electron. Kaufmann's published photographs do not appear to show any sign of this double trace. Hence, provided that the force $1/c(\mu[vX])$ has a real existence, Kaufmann's experiment shows definitely that the free electron cannot possess any spin comparable with that required by Goudsmit and Uhlenbeck's theory. This, of course, applies only to free electrons, and does not preclude the possibility that the electron may possess such a spin when it is a constituent part of an atom.

L. C. JACKSON.

Liver Extracts in the Treatment of Malignant Disease.

THE liver is proportionately very large during early fœtal life when rapid growth is the most prominent factor in the life of the organism. Since the formation of bile has not commenced at this stage of existence, the relatively large size of this organ may be attributed to the probability that it exercises some influence on the growth of the body. This effect would be brought about presumably through the medium of an internal secretion. As malignant disease in its various forms is primarily a manifestation of abnormal cellular growth, I attempted to determine the presence of such an

active principle and to isolate it in a form suitable for therapeutic use.

The work was initiated in the laboratories of the Hamilton General Hospital with the co-operation of Dr. W. J. Deadman. Extracts of fœtal pig livers were used during the earlier stages of the work on animals. Later extracts of both fœtal and adult pig livers were employed in the clinical work. The preparations were first administered to mice in which Marsh tumour tissue had been transplanted, an equal number of transplanted animals being untreated and used as controls It was noted that as compared with the controls the extension of the transplanted tissue was arrested in the mice under treatment, and with repeated injections distant from the site of the tumour, a total necrosis of the transplants occurred. The degeneration of the tumour tissue did not take place in the centre of the mass as normally occurs, but commenced at the periphery of the growth.

The work was afterwards transferred to the McGregor-Mowbray clinic of Hamilton, which has borne the entire expense of the earlier chemical investigation, and under the supervision of which all the clinical research has been carried out. The preparations which were originally employed contained relatively small quantities of the active principle. Recently the co-operation of Profs A. Bruce Macallum and A. A. James, of the Department of Biochemistry of the University of Western Ontario, London, has been enlisted, and they have developed a preparation from beef livers which contains the active principle in a highly concentrated form and can be rapidly and economically prepared. These preparations effect no changes in the blood pressure.

The clinical results to date in those patients who have received the treatment may be summarised as follows: in one patient there was complete disappearance of the tumour mass; in others still under treatment a reduction in the size of the growth has been noted. In every case the progress of the disease has been arrested and the life of the patient prolonged beyond that of the prognosis given before treatment commenced. So far only inoperable and otherwise hopeless cases have been treated No radical claims are advanced for this treatment, but the results obtained clinically have warranted a more extensive investigation which is now being carried out at the University of Western Ontario, London, and the McGregor-Mowbray Clinic, Hamilton.

This preliminary communication is made for the purpose of scientific record.

JOHN R. HOWITT.
Department of Biochemistry Medical School,
University of Western Ont.,
London, Ont.,
July 8.

Kammerer's Alytes.

As I was intimately connected with Dr. Kammerer's visit to England in 1923, and as his specimens were unpacked in my laboratory and examined there before being taken to Cambridge, perhaps I may be allowed to make some comments on Dr. Noble's communication to NATURE of August 7. As to the present condition of the Alytes, about which there has been so much controversy, I know nothing. Dr. Przibram's view that the specimen after its return to Vienna was allowed to fade and macerate and that then a clumsy attempt at 'faked' restoration was made, appears to me probable. But this specimen was demonstrated to a continuous stream of critical observers for a whole afternoon in the Zoological Laboratory at Cambridge by Dr. Kammerer, who removed it from its case and invited examination under a lens. We all saw the spines; it was these and not the colour which convinced us. Dr. Noble may set his mind quite at rest as to the former existence of nuptial asperities.

I possess a print of the photograph which shows them —it is not a question, as Dr. Noble imagines, of two or three spines but of a whole series of minute spines regularly spaced which can be clearly seen in profile along the edge of one of the fingers.

In the attack which he made on Dr. Kammerer at the meeting of the British Association last year, Dr. Noble laid great stress on the peculiar glands characteristic, as he said, of the nuptial pads, indeed, as he then stated, diagnostic of them, whilst the asperities were irrelevant. By his reference to Champy's paper in his present letter it is clear that he has since discovered his mistake. The glands found in these pads are merely the ordinary skin glands hypertrophied under the influence of the sexual hormone as the breeding period approaches. I have compared photographs of the sections through the normal skin of Alytes and through the 'pad.' The skin glands in the latter section are double the size of those in the former.

In conclusion, I may say that when Dr. Kammerer came to my laboratory in 1923 he brought other specimens about the existence of which I was sceptical until I saw them and which struck me as much more wonderful than Alytes. I refer to the large-eyed specimens of Proteus.

I suggest that Dr. Noble and his colleagues, instead of making aspersions on the good faith of a fellow-worker and the credulity of English scientists, would be better employed in endeavouring, as I have done, to repeat Kammerer's experiments, and when they have produced anything half as wonderful as the Proteus their comments will be listened to with more patience. E. W. MACBRIDE.

The Birefringence of Crystalline Carbonates, Nitrates and Sulphates.

IN two very interesting papers (*Proc. Roy. Soc.*, vol. 105, p. 370, and vol. 106, p. 346, 1924) Prof. W. L. Bragg put forward an explanation of the strong birefringence exhibited by the crystalline carbonates and nitrates. Expressed very briefly, his theory is that in the carbonate and nitrate ions the oxygen atoms are situated in one plane around the central carbon or nitrogen atom, as the case may be, and that, as the result of this arrangement and of the mutual influence of the electric doublets induced in the atoms by the field of the light-waves, the refractivity of the group depends to a marked extent on the direction of the light-vector. The refractive indices of the crystal were successfully computed on this basis. The crystalline sulphates are known, on the other hand, to have a very weak birefringence, and the suggestion was made that very probably the oxygen atoms are arranged tetrahedrally round the sulphur atom in the sulphate ion group, thus making it optically isotropic.

Very interesting evidence regarding the birefringence of the nitrate and sulphate ions is furnished by some recent observations on the scattering of light by concentrated acids and their aqueous solutions made in the present writer's laboratory by Mr. S. Venkateswaran. The light scattered by dust-free nitric acid is found to be nearly unpolarised, indicating an extremely large anisotropy for the nitric acid molecule and for the nitrate ion. Concentrated sulphuric acid and its aqueous solutions, on the other hand, polarise the scattered light nearly completely, indicating that the sulphate ion is nearly isotropic optically. We

have thus a striking confirmation of Prof. Bragg's views.

Observations on the scattering of light by concentrated solutions of salts and by organic vapours containing the groups in question have been undertaken. One may venture confidently to predict the results to be expected. C. V. RAMAN.

210 Bowbazaar Street,
Calcutta, India,
June 10.

The Reduction of Carbonic Oxide.

EVEN politicians are attracted to this problem and see in it not red but the oils of to-morrow. If peers speculate in futures, why not we plebeian sciencers, who give our lives to such matters, not a princely two days or so? The victim of a pernicious complaint contracted in the service of the British Association in the granitic environment of Aberdeen, pursuing the vicious line of thought which has afflicted me since 1885, I have recently been led to make logical use of my singular views on the course of chemical change and apply them fully to this most remarkable, perhaps *the* most remarkable, of molecules—carbonic oxide. No other molecule has 'taken us in' so long. All my life I have been seeking to fathom its mysterious depths: even now I don't feel in safe soundings.

I have argued, before the Royal Society and at the recent Solvay Conference, that it is not directly oxidisable by oxygen: the potential of the circuit would be too low. Prof. Bone and I are duelling over this issue at the moment: the foils are to be without buttons.

If my line of thought regarding its oxidation be sound—I seem to see signs that the force of facts is beginning to tell in its favour, at the same time that trousers are no longer all built turned up, those who dabble in science being as unable as are ordinary mortals to follow one fashion for ever—the reverse operation, the direct reduction of the gas by hydrogen, should be equally impossible, catalyst or no catalyst. Some adjuvant action must intervene to effect reduction if the carbonic oxide-hydrogen potential be below the oxygen-hydrogen potential. F. Fischer's suggestion that the process is an indirect one is, therefore, of special interest. The modifications of the fundamental equation given by Messrs. Elvin and Nash (NATURE, July 31, p. 154) are no more likely than that equation is as an expression of the character of the chemical change. Metallic carbonyls are perhaps concerned in the transformations.

HENRY E. ARMSTRONG.

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Lewisham, S.E. 13.

Operation of Fog-Signals from a Distance.

IN the issue of NATURE for July 10, p. 58, reference is made to an installation for the operation of fog-signals from a distance. I wish to direct attention to two misstatements. The apparatus is not automatic in the strict sense of the term, as it requires to be started and stopped by human agency. The statement "These guns are the only automatic signals at present in use" may apply to the Clyde, but there are two lighthouses in the port of Dublin which are equipped with automatic fog-signalling apparatus, and these have been in operation there for almost two years. The system in Dublin depends on the interruption of a beam of light by fog. The light beam traverses the channel in an oblique direction over a distance of about half a mile, and the apparatus upon which the light acts is so arranged as to respond when the visibility falls to a dangerous degree. These lighthouses in Dublin were undoubtedly the first completely automatic lighthouses to be in operation. JOHN J. DOWLING.

University College,
Dublin, July 13.

I REGRET to have to confess ignorance about the two lighthouses in Dublin Bay. It would be of interest to know whether smoke from a passing steamer affecting the beam of light causes the 'guns' to act. I am well aware that engineers have often discussed the proper use of the word 'automatic.' Automatic telephony, for example, is not automatic in the strict sense of the term. It would take too long to discuss this fully, but personally I object to 'semi-automatic.'

THE WRITER OF THE NOTE.

Scientific Neglect of the Mas d'Azil.

L'ÉTAT d'abandon que l'illustre écrivain M. Wells signale pour la caverne du Mas d'Azil est réel et fort regrettable, bien que les conséquences en soient probablement moins graves qu'il ne pense. Elle appartient à l'état, mais la commune en a l'usage de temps immémorial. Le cantonnier chargé de l'entretien de la route départementale qui la traverse en est le gardien officiel; c'est lui qui fait visiter les galeries obscures, plus intéressantes par le pittoresque que pour la science préhistorique, bien que de rares dessins pariétaux s'y rencontrent, et, deci-delà, quelques menus vestiges de fréquentation humaine. Sur la rive droite, le point important était la salle du Foyer et sa galerie inférieur. La salle du Foyer a été fouillée depuis longtemps dans sa totalité par Piette, Ladavèze, Maury, etc, et en dernier lieu (1901–1902) par moi-même. Je doute qu'elle contienne actuellement autre chose que les déblais de ces fouilles, sauf son couloir inférieur, où existent quelques peintures étudiées par le Comte Bégouen et moi. Les couches archéologiques peu épaisses qui y subsistent vers le fond sont sans doute l'objet des grattages dont M Wells nous entretient. Plus grave est le bouleversement réalisé l'année dernière dans cette région de la grotte par la municipalité pour y installer un théâtre. Mais je ne crois pas que les lieux de la caverne contenant encore du gisement, placés sur l'autre rive, aient été touchés récemment: une épaisse couche de pierrailles et de terre poudreuse les défend bien. H. BREUIL.

Preservation of Mammalian Spermatozoa.

IT may be of interest that experiments on the preservation 'in vitro' of mammalian spermatozoa show some prospect of successful application to the transport of semen to a distance; a problem of considerable importance in animal husbandry. Spermatozoa from a rabbit were sent by post from Cambridge to the Animal Breeding Research Department, University of Edinburgh. From 5 does inseminated, 46-49 hours after despatch, 3 produced litters of 8, 11, and 2 respectively. One doe died without diagnosis of pregnancy and one proved infertile.

Although the technique excludes the practical application of this particular method to the domesticated animals, further experiments are in progress, and it is hoped that these difficulties will be overcome.

ARTHUR WALTON.

Institute of Animal Nutrition,
Cambridge, July 29.

The Production of Single Crystals of Metals and some of their Properties.[1]

By Prof. H. C. H. CARPENTER, F.R.S.

THE problem of preparing a piece of metal in the form of a single crystal may be approached in one of two ways. As ordinarily prepared, metals and alloys consist of a large number of small crystals the size of which varies in the great majority of cases from about 100,000 to several million in a cubic inch. These result from the fact that when the metal or alloy freezes, crystallisation takes place at a large number of centres and the crystals grow until they meet one another. The boundaries, therefore, are produced by the meeting of these crystals and vary very much in shape. The net result is rather similar to that of a jig-saw puzzle, for the crystals are oriented quite at haphazard. The shapes and sizes of these crystals may be altered by working and heat-treatment, and the precise rearrangement may go so far as to result in the birth of new crystals, but the net result is always an aggregate of comparatively small crystals.

The properties of metals and alloys are the properties of these small crystals, and are due to two factors—(*a*) the crystal itself, and (*b*) the crystal boundary. In the crystal itself the atoms are arranged in a particular pattern corresponding to the symmetry of the metal. At the boundary, on the other hand, this condition does not obtain. For example, where two crystals are in contact atoms meet in two different directions, while at the place where three crystals touch, atoms meet in three different directions, and so on. It has been known for some time that the crystal boundary is stronger than the metal crystal, in the sense that normally when a metal is fractured it breaks through the crystal and not along the boundary, and the fracture of a metal test-piece is the summation of a large number of fractures running through small crystals. Hitherto it has been impossible, except in a very few isolated cases, to determine the properties of a metal crystal apart from those of the crystal boundary. The great and indeed fundamental interest of the problem of preparing a piece of metal in the form of a single crystal, therefore, is that its solution would enable the properties of the metal crystal to be determined.

SINGLE CRYSTALS FORMED DIRECT FROM THE LIQUID.

Evidence has been in existence for some time that, provided that the right conditions obtain, very large crystals can be grown from the liquid. The famous Tschernoff crystal dates back to about 1880. It was a large iron crystal, which he noticed in the 'riser' (head) of an ingot at the Vickers' works in Sheffield, and was upwards of 6 in. in length. Its shape was peculiar, and was what is called a 'crystal skeleton'—*i.e.* it had grown along the crystallographic axes to a greater extent than the filling-in process had occurred, and the net result was something which looked very like the branch of a pine-tree. Other instances of the accidental occurrence of large crystals have been noticed by Osmond and Cartaud, Moellendorff and Czochralski.

So far as I have been able to discover, the problem of preparing a single crystal direct from the liquid was first solved by Czochralski in 1918. He prepared long thin threads of crystals by drawing out a rod at a particular rate from the molten metal. As the rod was withdrawn the metal solidified and the resulting wire (0·5 mm. diameter) was found to consist of one crystal. Success was thus achieved with tin, lead, and antimony. Later Gomperz improved the technique of Czochralski's method. He used a silica rod on which to deposit the crystal growing from the melt and surrounded this with a neutral gas.

Quite recently (1923 and 1925) P. W. Bridgman has prepared much larger single crystals by melting the metal in a tube tapered at one end to a point and lowered through the furnace at a given rate. He found that if the lowering is at a speed less than the velocity of crystallisation and slow enough for the heat of solidification to be dissipated by conduction, then the metal will usually crystallise as one grain, provided that only one nucleus started at the bottom of the tube. In this way he prepared crystals of antimony, bismuth, cadmium, tellurium, tin, and zinc. It is particularly interesting to notice that this method also holds for metals having a polymorphic transition point (tin and antimony).

The melting was carried out *in vacuo*, and great stress is laid on the importance of freedom from dirt as an essential condition of success. At some little distance from the bottom the tube was constricted to a capillary, 0·1 mm. in diameter. It was found that one orientation of the crystals is usually more favourable for growth than others, so that even if crystallisation starts from more than one centre at the bottom, that crystal will eventually win through the capillary which is most favourably situated. Bridgman found that the most favourable orientation is, in almost all cases, when the plane of easiest cleavage or slip is parallel to the axis of the casting. In this way single crystal rods up to a diameter of 2·2 cm. were prepared. The same device was adopted by Obreimow and Schubnikow.

Valuable work on the single crystal wires produced by Czochralski's method and their distortion by mechanical stress has been carried out by Polanyi, Schmid, and Schouborn, while Bridgman has determined a number of physical properties of his single crystals of metals, which were purposely chosen because they did not possess the highest symmetry and therefore might be expected to give different values in different directions. This expectation was fulfilled.

SINGLE CRYSTAL TEST-PIECES FROM PRE-EXISTING CRYSTALS.

Here, again, a study of the literature showed it to contain a number of observations which indicated that, provided that the right conditions were obtained, success might be achieved in this direction, although the chances did not appear so good as that of preparing

[1] From the sixteenth May Lecture to the Institute of Metals, delivered on May 19.

a single crystal from the melt. Sauveur was, I think, the first investigator to show that, by carefully straining and afterwards heating metals, crystals of a much larger size than the normal could be produced, and stated that there was a critical stress which produced the largest crystals. Afterwards Ruder, Chappell, Jeffries, and Hanson showed that if a metal is locally deformed and then heated, exceptionally large crystals form at some distance from the point at which stress is the severest. If a tapered test-piece was used a 'strain gradient' was obtained, and it was found that the largest crystals always formed within the strained region, but farther from the area of greatest strain the higher the temperature. Seligman and Williams, working in my laboratory, stretched aluminium sheet, which had been previously heated, to various degrees, and found on heating that, up to a certain point, a small deformation had no effect. Beyond this, however, large crystals were formed, and as the deformation was further increased the crystal size was diminished. The crystals produced by these methods were very large compared with those in the original metal, some of them being 0·5 in. long.

In recent years wires have been produced, originally by accident, both of tungsten and molybdenum, in which crystals occupy the entire cross-section of the wire. This is done by drawing the metal through dies at a certain rate and temperature. Sykes, experimenting on molybdenum wire, obtained crystals 0·5 in. long, with an average diameter of 0·013 in.

Experiments on the production of single aluminium crystals were begun several years ago by Miss C. F. Elam, my research assistant, and myself. For many months we studied the structural changes produced in a crystal aggregate by deformation followed by heat, which may be summarised as follows: The first effects of strain are revealed by the presence of slip-bands, and in some cases of twin crystals. The former are completely, and the latter to some extent, removed by heating. No change is observed in the shape of the crystals. Somewhat greater deformation, however, followed by heat, produced actual crystal growth, and at this stage the boundaries of the crystals became active. This activity is shown in the capacity of the growing crystal to push forward its boundaries in certain directions, thus invading other crystals, upon which it imposes its orientation. A still greater deformation produces a change which appears to take place exclusively in the boundaries of the deformed crystals. It is here that new crystals are born, possessing a different orientation and a much smaller size. Accordingly, in this third stage there is a refining of the crystal structure. From the point of view, therefore, of producing large crystals from an aggregate of small ones, the intermediate degree of strain, just referred to, is the important one.

The increase in crystal size could be clearly followed in our experiments with an alloy of tin containing a little antimony, where the actual movement of the crystal boundary was observed and photographed. Our experiments further showed that in the absence of a change of phase neither crystal growth nor recrystallisation will take place in a metal unless it has been plastically deformed and afterwards heated to a certain minimum temperature for a certain minimum time. They also showed that there is no gradual increase in size from the original crystals up to the largest, but that the latter appear to form directly from them. It is clear therefore that, in the production of large metal crystals, the adjustment between mechanical strain and the temperature of heating is extremely important.

This point can be clearly illustrated in the case of the metal aluminium. Test-pieces, after preliminary heat-treatment to remove work hardness and render the crystals so far as possible equiaxed, were subjected to varying degrees of strain. After this they were all heated to 550° C. for 6 hours. Finally, they were etched in a 10 per cent. solution of caustic soda. Below the minimum strain required for growth, the crystal size remains unaltered. At the critical strain large crystals suddenly appear. Above this the size diminishes in proportion as the strain increases.

PRODUCTION OF SINGLE CRYSTALS IN SHEETS.

By this time we were ready to approach the problem itself, and our first experiments aimed at converting the crystals in the parallel portion of a test-piece 4·0 in. × 1·0 in. × 0·125 in. of aluminium into a single crystal. Calculation showed that the total number of crystals contained in the parallel portion of the test-piece was about 1,687,000.

After many months of work success was achieved in the following way: The test-piece must, in the first place, be accurately machined along the parallel portion. In order to convert this into a single crystal three treatments are necessary: the first thermal, the second mechanical, the third thermal. The first treatment is necessary to soften the metal completely and produce new equiaxed crystals of so far as possible uniform size, the average diameter being $\frac{1}{150}$ in. The second consists in straining these crystals to the required amount, and the third in heating the strained crystals to the requisite temperature, so that the potentiality of growth conferred by strain could be brought fully into operation.

The most suitable temperature of the first heating was found to be 550° C., and the time 6 hours. The precise degree of strain for the aluminium used was an elongation of 1·6 per cent. on 3 in. produced by a stress of 2·4 tons per sq. in. The final heat-treatment was begun at 450° C., and the temperature raised at about 25° C. per day up to 550° C. It was then brought finally up to 600° C. for one hour, in order to complete the absorption of small crystals on the surface, which persistently remained at lower temperatures. On an average, one test-piece in four is converted into a single crystal in this way. The boundary at each end extends in the form of an irregular line into the wide head of the test-piece. The time required for the single crystal to grow in this way is therefore about 100 hours.

The conditions laid down by us for the production of a single crystal were that every crystal in the complex should be strained a certain small amount, and that one of them should be strained rather more than all the rest. We were originally disposed to think that the crystal which grew and absorbed all the others was the one most highly energised by strain. Later investigations with X-ray analysis, however, have shown that

single crystals produced in this way are free from strain, and we have accordingly modified our view and consider that the most highly strained crystal deposits a nucleus free from strain upon which all the other crystals ultimately align themselves, thus producing an unstrained single crystal.

PRODUCTION OF SINGLE CRYSTALS IN BARS.

We next proceeded to apply these methods to the production of single crystals in round bars. We found that, provided that the same conditions as to accuracy of machining, correct crystal size, degree of straining, and final heat-treatment were maintained, single crystals could also be produced in round-bar test-pieces, both in diameters of 0·564 in. and 0·798 in. Single crystal test-pieces 9 in. long and 0·564 in. in diameter have been prepared in this way.

Deformation of these test-pieces under tensile stress is very remarkable. On one hand, the 'normal' bar, consisting of small crystals, drew down with a roughening of the surface, a cup and cone fracture, and the maintenance of a circular cross-section throughout. On the other hand, when a single crystal was pulled in this way it produced an ellipse. As the test proceeded the ellipse became narrower and narrower in one diameter, while the other diameter remained nearly constant. Presently a point was reached when a characteristic lens-shaped figure was formed. As the bar pulled apart this became smaller and smaller. Eventually fracture took place at each side and ultimately in the middle.

The final result was that the fractured surface of each half of the test-piece was a very acute ellipse or wedge, the metal being grooved in each case. Characteristic flow lines also made their appearance on the test-pieces, corresponding to the slipping of the metal in this remarkable and quite novel way. They may be called 'glide-ellipses' Here, again, the properties varied considerably in different specimens, the tenacities ranging from 3·0 to 4·0 tons per sq. in. and the elongation from 57 to 85 per cent. In some of these experiments the volume of the single crystal exceeded 2 cu. in., which means that about 7,000,000 crystals had coalesced in their formation.

It has not been found possible to produce single crystal test-pieces of square bars. Owing to the shape, these fail to strain uniformly, and, on heating, crystals grow from the four corners and meet in a line in the middle of the four sides. Some of the crystals were from 2 in. to 3 in. long and were visible on two adjacent sides. Remarkable effects were obtained on breaking them. In some places the corners became rounded, while in others they were narrowed to a ridge of almost knife-edge thickness. The whole bar became very much twisted and distorted.

ANALYSIS OF THE DISTORTION OF SINGLE CRYSTAL BARS.

The distortions of the single crystal test-pieces produced both in sheet and bar forms were very remarkable, and clearly suggested that the crystal axes were not oriented in the same direction in each specimen. In discussing this matter with Mr. (now Prof.) G. I. Taylor, he thought that it would be a straightforward, though possibly laborious, task to determine the relationship between the orientation of the axes and the distortion produced in a tensile test, and that by examining a number of specimens some general results might be obtained about the forces necessary to produce distortions of this type. He kindly agreed to join us in the work of testing these matters. Before the test contemplated could be carried out, however, it was necessary to obtain the help of an expert in crystal analysis by X-rays. Dr. A Müller accepted our invitation, and succeeded in devising a satisfactory method of determining the orientation of the crystal axes in single crystal bars by means of X-rays.

For the purpose in hand it was necessary to work with a square bar. As already mentioned, single crystals cannot be grown in square bar form. We had, therefore, to produce a round single crystal test-bar and then to machine it down until its section was square. The method of investigation adopted was as follows: Each face was marked by a scratch parallel to the length of axis of the specimen and by cross scratches at 0·5 in. intervals. The faces were numbered 1, 2, 3, and 4, so that when the specimen was placed upright in the testing machine the faces appeared in this order when the observer moved round the machine in an anti-clockwise direction. At each successive stage of the test the extension between each pair of cross marks was measured on each face. At the same time the angles between the cross scratches and the longitudinal scratch were measured in each case. In addition, the thickness of the specimens between pairs of opposite faces and the angle between neighbouring faces were also measured. These suffice to determine the nature of the distortion.

Measurements showed that near the ends of the specimen, where it was held in the grips of the testing machine, the measurements were not quite the same as those near the middle, but that the central portion was nearly uniformly strained There is a high degree of uniformity among the measurements of extension in the three middle compartments of each face, especially in the earlier stages of the test.

Measurements were made at extensions of 5, 10, 15, 20, 30, 40, 60, and 78 per cent., when the crystal broke. As the test proceeded the square section of the bar gradually disappeared, and the final result was a parallelepiped of remarkable form. The cross scratches, although remaining rectilinear, shifted by a definite angle which became markedly acute. When the specimen finally broke, it contained two very acute and two very obtuse angles.

Prof. Taylor and Miss Elam followed up this work with a paper published in 1925. In this they have described similar experiments made with several more specimens in order to find out whether the conclusions previously reached are general in their application and to settle several points which the previous experiments left in doubt. The chief result of their earlier work was to show that of the twelve crystallographically similar possible modes of shearing, the one for which the component of sheer-stress in the direction of shear was greatest was the one which actually occurred. The first object of the later work was to determine the orientation of the crystal axes of several specimens.

Assuming that the relationship outlined above holds in general, it is possible to predict the orientation of the plane on which slipping should occur. Three more single crystal test-pieces were stretched and their distortions analysed by the method already described. It was found that in each case the distortion was such as would be produced by shearing parallel to a single plane, and that this plane of slip was the one predicted. It was also found that the changes in orientation of the crystal axes relative to the axis of the specimen during the test were in good agreement with the prediction.

In the previous work it was not possible to make a detailed analysis of the deformation during the last stages of the stretching, but it was shown that the deformation ceased to be due to slipping on one crystal plane. Reasons were given for supposing that the deformation might be due to slipping on two crystal planes simultaneously, and it was shown that the crystal axis which formed the intersection of these two planes remained unstretched during the test, as it should if the distortion were in fact due to this cause. There are, however, a number of other types of distortion which might also leave this particular axis unstretched. In their later paper Taylor and Elam showed that for a small distortion the 'unstretched' cone passes through or very close to three other crystal axes, which, in fact, determine all the possible kinds of unstretched cone which can be produced by double slipping of the type contemplated. This completes the proof that the slipping in the last stages of the test is of this type.

When the crystal begins to slip on a second plane it seems likely that the rate of slip on each plane would be the same. In this way they would remain inclined at equal angles to the axis of the specimen, but it was impossible to verify this suggestion from the previous experiments. The second paper contains the test of this, and it is found that, although double slip does begin when two planes get to the position in which they make equal angles with the axes, the rate of slipping on the original slip plane is sometimes greater than it is on the new one. The two planes do not, therefore, necessarily remain at equal angles with the axis, but the process cannot be followed very far because the specimen usually breaks when only a comparatively small amount of double slipping has occurred.

A most interesting test described in this paper was that in which the authors distorted a single crystal test-piece, in which they predicted that from the original position of the crystal axes double slipping should begin at once. A specimen was found the axes of which corresponded very closely to this position, and it was found that double slipping did occur during nearly the whole extension. In this case it was found that the amount of slipping on the two planes was practically equal, and that the axis of the specimen remained very close to the (112) axis during the whole test.

A point of which Taylor and Elam made special mention was the extraordinary uniformity of the stretched specimens. They showed a photograph of specimen No. 68 which had been stretched to an extension of 70 per cent. To the eye it appears absolutely uniform. They gave numerical data as to the variations in extension of different parts of the specimen, and found that the average variation of ϵ was 0·0028 during the first 5 per cent. Up to 20 per cent. extension the variation did not exceed this figure; it then began to increase, until at the breaking point it rose to 4 parts in 100.

The chief conclusions drawn by the authors from the theory of fracture contained in their paper are—(1) that with a stress-strain curve of the type found by them, fracture of aluminium single crystals cannot occur by slipping on a single crystal plane, and (2) that the geometrical conditions alone imply that fracture takes place more easily when double slipping occurs than when all the slipping is confined to one plane.

Miss Elam and I have recently investigated the distortion of single crystal test-pieces of aluminium followed by subsequent heating. We have found that the crystals can be deformed so much as 7 per cent. without being destroyed on heating. Beyond this amount the metal recrystallises and breaks up into a number of smaller crystals the size of which depends on the amount of distortion. Near the fracture the crystals are smallest and they increase in size towards the shoulders of the test-piece. The recrystallised metal shows exceptionally straight crystal boundaries, and the crystals are frequently twinned.

We then made a detailed examination of the behaviour of two round single crystal test-pieces after successive increments of strain followed by heating. The orientation of the bar was first determined by means of X-rays, and the metal then extended 5 per cent. The position of the crystal axes was then determined, and it was found that the reflections on the photographic plate were not so well defined and were spread over a large reflecting angle. The crystal was then heated to 400°, 500°, and 600° C. and examined after various periods at these temperatures. No change appeared after this treatment. The nature of the X-ray reflections was unaltered, and there was no change in the position of the reflecting planes. After a second extension of 5 per cent. the positions of the reflecting planes were redetermined and the bar heated to 350° and 450° C. No change was observed. After heating at 550° C. the reflections that had been found previously had disappeared, but new ones were obtained in other positions.

A comparison of the reflecting planes from different parts of the bar, including opposite sides of the same reference plane, showed that it was still a single crystal, but that it possessed an entirely different orientation from that of the original. Moreover, the X-ray reflections now obtained were sharp and well defined as in the original crystal. Etching in caustic soda revealed a homogeneous structure. Further extension of 5 per cent. produced results similar to the first extension, and heating up to 600° C. produced no change. On heating after the fourth extension, however, the orientation was found to have changed once more, but the bar still remained a single crystal. The process was again repeated, and after the sixth extension a partial recrystallisation took place. Another single crystal test-piece was subjected to this treatment with exactly similar results. Here again the crystal moved successively into two new positions.

The Problem of the Origin of Species as it appeared to Darwin in 1859 and as it appears to us To-day.[1]

By Prof. HENRY FAIRFIELD OSBORN, For. Mem. R.S.

The first of these objects, that is, the establishment of a belief in descent with modification, was always held by my father to be the more important of the two; for I once heard him say, if a recollection of about fifty years' standing may be trusted, that "after all, evolution is the great thing, not natural selection."—LEONARD DARWIN, "Organic Evolution," pp. 1, 2.

NEARLY one hundred years ago Charles Darwin began to collect facts for "The Origin of Species," his immortal work, which was cautiously withheld from publication until 1859. There still prevailed the zoology of Linnæus and Buffon and the palæontology of Cuvier. In Lesson's "Mammalogie" (1827) the number of mammalian species is exactly 1124, as compared with the 13,450 species and subspecies of mammals known at the end of the year 1925. Birds increased from 3600 to 23,939; reptiles and amphibians from 543 to 9000; fishes from 3500 to 20,000. Darwin's species stood apart like isolated mountain peaks, whereas to-day living species and subspecies are often comparable to mountain chains composed of lesser peaks completely connected by ridges known as intergradations. It is not the number of species and subspecies which is significant, but the facts as to habit and habitat which are recorded with them. Similarly, it is not the number of fossil species now known as compared with those of Darwin's time, but the *linkage* of families, genera, species, subspecies, and even of 'ascending' and 'descending mutations' reaching back over hundreds of thousands, if not millions, of years.

This twenty- to one hundred-fold disparity in our knowledge simply intensifies our admiration for the courage of Darwin in boldly substituting a natural for a supernatural conception of the origin of species. It is true that Darwin's most influential authority was not the current zoology and palæontology of his day but Nature itself, whereby even in 1859 he absolutely established the Law of Evolution, as well as the directing and standardising principle of Natural Selection. It is, however, not this broader aspect of evolution, but the more concrete problem of the *modes* and *causes* of the origin of species which we are considering to-day.

Let us re-examine these causes in the light thrown by naturalists and observers on the invertebrates and vertebrates as distributed over the great continents of Europe and Asia, of North and South America, of Australia, considered not alone with their present boundaries but also with their former land connexions secured by elevation to the hundred fathom line. In this connexion I present a new zoogeographic and palæogeographic map of the world, prepared with the aid of Bartholomew of Edinburgh. We shall see that the results of zoological and palæontological research are entirely harmonious and concordant, but that zoology, while clearly teaching certain principles of the origin of species, leaves blank many gaps which are completely filled by palæontology.

Thus these two branches of biology are complementary in demonstrating that, through observations after the very naturalistic manner of Darwin in the voyage of the *Beagle* and through the very Lyell-Darwin methods by which the natural origin of species was originally discovered, *the problem of the origin of species has entirely changed in the last hundred years.* In fact, were the great naturalist living to-day, he would be foremost in modifying his own opinions, speculations and theories.

Greatly enhancing the value of the recent work of our field naturalists is the fact that the results reached in fishes, amphibians, reptiles, birds and mammals were recorded entirely independently of each other. Where the conclusions reached are harmonious or concordant they have the convincing value of entirely independent testimony. Also, these results are doubly valuable because they are for the most part assembled without biological purpose or intent, not to prove or to disprove any particular theory, but recorded simply as actual observations.

This is generally true of all field naturalists, who are more concerned about Nature than about the interpretation of Nature. The interpretations upon which our field naturalists do venture, such as the 'direct action of environment,' and 'Lamarckian inheritance,' are often lacking in real biological analysis. For such analysis, therefore, we must allude to five biological principles which have developed from laboratory experiments, and the generalisations growing out of them, beginning chiefly in the year 1880. These are as follows:

(1) Weismann's sharp distinction of the germ-plasm from the body plasm, from which follows the equally sharp distinction between truly germinal specific characters and bodily modifications by environment or habit; (2) the experimental failure of the inheritance effects of adaptive habit, known as Lamarckism; (3) the apparent failure of the environment to modify immediately the germ-plasm in creating adaptive specific characters; (4) the sharp limitations of the originative powers of Natural Selection as conceived by Darwin; (5) the sharp distinction between the continuous and discontinuous (or mutational) origin of specific characters.

In fact, the outstanding speculations of Darwin's and Herbert Spencer's time as to the causation of the origin of species have been pared down by laboratory analysis to a mere vestige of their former selves, and the overweening confidence of one school of causation after another has been displaced by diffidence, doubt, or even agnosticism, as expressed in the final address of William Bateson, whose recent death we lament at this meeting. To sum up, intensive laboratory and experimental research has added vastly to our knowledge of the functions of animals and of the heredity mechanism but has greatly increased the difficulties

[1] Read before Section D (Zoology) of the British Association, at the Oxford meeting, August 5, 1926. This is the fourth of a series of papers on the origin of species, the first having appeared in NATURE, June 13 and 20, 1925, under the title, "The Origin of Species as Revealed by Palæontology."

inherent in the problem of the origin of species. It is the *modes* and the *causes* of the onward progressive movement of the germ-plasm resulting in the consecutive origin of new adaptive specific forms which are rendered still more mysterious by the negative results of laboratory research.

DISTINCTION BETWEEN SPECIATION AND MUTATION.

So far as the *modes* of the origin of species are concerned, these negative results of the laboratory are more than offset by the positive results obtained by our field naturalists and explorers who are independently discovering a considerable number of species-in-the-making at the present time. In other words, we now understand the contemporary origin of species after modes and under conditions wholly unknown to Darwin in 1859. Geographic *isolation*, to which Darwin's attention was first directed by Wagner, with all the incidental influences of physical or chemical change, of enforced change of habit, of competition with a new life environment, perhaps of stimulus to the germinal energies themselves, seems to constitute the chief complex of causes in the origin of new species; this complex is summed up in the principles which Osborn terms *tetraplasy* and *tetrakinesis*. An extreme phase of isolation is *insulation*, where species are scattered among a number of islands. A like isolating mode among fishes is seen in the complete separation of rivers and streams formerly connected. In this complex of four coefficient causes, all involving energy, the specific germinal substance itself undergoes change, extremely slow but continuous, so that a new stage is very gradually reached, formerly known as a 'geographic variation' but now known as a 'subspecies.' Between subspecies living in islands and separated rivers there are naturally no *intergrades* or intermediate stages, but in a number of independent examples among fishes, amphibians, reptiles, birds and mammals, true intergradation has been observed linking one subspecific form with another in a continuous germinal life-chain. Such survival of intergrades may be instanced as proof of *complete continuity* between subspecies and, consequently, between species.

This appears to be the normal and natural mode of origin of the greater number of specific forms as observed in zoology; such mode has been termed 'speciation' by recent British and American authors. In exactly the same field of observation and by the same observers, apparently as an abnormal mode due to some irregular influence on the specific germ-plasm, is seen the discontinuous or sudden origin of new characters, ranked by some observers as specific, after the manner termed 'chance variation' by Darwin and 'mutation' by De Vries. *Mutation* thus appears to be a real phenomenon, but a relatively rare one; such mutational origins need to be protected by geographic or climatic isolation from interbreeding with normal species.

Thus *speciation* through continuity stands in contrast with *mutation* through discontinuity. There is no question as to germinal change in mutations, but may the same be said of subspecies? In answer to this doubt it has recently been shown by experiment (Sumner 1924) that many, if not all subspecific characters are ***stable under changed conditions of environment***. Consequently, while under suspicion as to reality, often vexatious and unconvincing, and always annoying to the systematist, ***well-authenticated subspecies are of priceless value to the biologist who seeks to ascertain the conditions under which new species arise.*** It proves that many 'geographic variations' and 'subspecies' are really germinal transitions, intermediates and intergradations from 'species' to 'species' of the higher kind known to Darwin.

The above is a summary of principles gathered from a very large number of independent observers whose names will be fully recorded with the titles of their papers in the complete series of notes on which the present paper is based. Outstanding names are those of Adams in the gastropods, Jordan, Berg and Regan in the fishes, G. A. Boulenger in the amphibians, E. G. Boulenger in the reptiles, Chapman and Griscom in the birds, Osgood and Sumner in the mammals. The whole list of observers in the vertebrates alone comprises more than a hundred names. For the annotation of this extensive literature I am indebted to members of the corps of zoologists of the American and British Museums and of the Zoological Society of London.[2]

EXAMPLES OF GEOGRAPHIC ISOLATION AND SPECIATION.

It appears that speciation arises only where one or all of the energy coefficients of Osborn is changed. In amphibia especially, geographic isolation does not invariably result in the origin of new species, because all the conditions of the new habitat may be identical with those of the old. A most striking example of complete intergradation between 'species' is that of the molluscan genus Io of the Tennessee River, which now presents all the living intergrades between the smooth and the spinose forms as we pass downstream. In fishes, skeletal intergrades are observed as we pass from northern to southern waters (Berg) or from a colder to warmer marine habitats; these intergrades consist in the number of vertebræ, of fin rays and of scales, and in body form and colour, and Berg concludes that all the individuals of certain geographic areas simultaneously produce similar new specific characters.

Among amphibians the entire region around the Mediterranean affords G. A. Boulenger a series of subspecies of the edible frog, *Rana esculenta*, more or less connected by intergrading forms. Among reptiles E. G. Boulenger observes the speciation of the skink, *Chalcides ocellatus*, a species which, like the edible frog, surrounds the Mediterranean, in which the difference between two isolated subspecific forms is so great that *were it not for the wonderfully complete manner in which they are connected they could not be denied full specific rank*. As among fishes, intergradations are observed in all the skeletal characters, as well as in the colouring and the scales. Completely supporting these observations are those of many of the recent herpetologists who conservatively use the word 'variety' where other authors use the word 'subspecies,' who imply that intergradations occur wherever a sufficiently large number of specimens are examined. Chapman, with extensive collections of South American birds at his command, records exactly similar results:

[2] These data will be published in full in a sequel to the present paper, in the *American Naturalist*, No. 5, in the series on the origin of specie

The ornithologist finds large forms occupying colder areas, dark ones humid areas, and pale ones arid areas; and as the [environmental] conditions which obviously produce these variations in size and colour merge one with the other, so do the [specific and subspecific] forms themselves intergrade. That these variations are inherent [*i.e.* germinal, constitutional, hereditary] and not merely the temporary impress of physical environment on the individual, is apparently shown by the fact that they are often as well marked in the nestling as in the adult.

Chapman also observes a distinct case of 'mutation' within the genus Buarremon in the presence of a black pectoral feather-band, which is established as a specific character by isolation or geographic discontinuity. Like the single case with black dorsal band observed within the genus Troglodytes, the mutation does not intergrade and is thus recognised as of discontinuous or mutational origin. Stresemann finds partial melanism as well as albinism arising as not infrequent mutational characters, but fails to show that these are adaptive. Chapman and Griscom in their North and South American field work distinguish clearly between intergrading and non-intergrading kinds of birds. In a collection of 1500 specimens of the house wren, Troglodytes, these observers have noted a considerable number of cases of *complete* intergradation between subspecies, and those familiar with the marked physiography of South America, with (*a*) its cold and arid Pacific coastal belt, (*b*) its Andean Mountain chain subdivided by Chapman into numerous vertical life-zones each clearly demarcated until we reach the boreal summits, (*c*) its vast Amazonian forest plain, (*d*) its pampas and plains of the south-east, and (*e*) humid forests bordering the Straits, may anticipate wide speciation in other forms of animal life in this continent. It is noteworthy that these observers have discovered in Troglodytes only one example of mutation in the sense of De Vries. It cannot be questioned that isolation is the most important factor in the speciation of birds, especially in its extreme form of insulation. As an example of wide isolation without speciation, the house wren of Florida, *T. ædon ædon*, exhibits the same characters as those of Tierra del Fuego, but in the intermediate regions another species, *T. musculus*, exhibits a large amount of subspeciation and several complete intergradations.

Among mammals the great transverse geographic range from Scotland across Eurasia and North America to New Brunswick, Canada, of three species of the deer family, affords a striking example of geographic speciation; the stag (Cervus) yields twenty-three species and subspecies; the moose (Alces) yields eight subspecies; the reindeer (Rangifer) yields twenty-one subspecies. This is in wide contrast to the knowledge of Darwin (1837–1859), to whom were known only two species of stag, one species of moose, and one species of reindeer. Far more significant, however, are the observations of Osgood and Sumner on the deer-mice of the genus Peromyscus, which range through the temperate region of North America to the Pacific coast. From a collection of 30,000 specimens Osgood finds that a subspecies is characteristic of every distinct climatic region and sub-region. These subspecies listed by Merriam and Osgood have been accepted with great reluctance, especially by naturalists unfamiliar with the excessively sharp geographic and climatic barriers of the western United States. Our hesitation to accept these subspecies as of real germinal or genetic value has been entirely removed by the persistent observations and experiments of the biologist Sumner, largely in the identical collecting grounds of Osgood, and we must welcome these combined observations and experiments as the most convincing demonstration of the principle of *speciation continuity* thus far afforded. Between at least six of these subspecies complete intergradations occur. Classification becomes like dividing the lines of the spectrum. After eight years of transfer from an arid to a humid environment, or vice versa, these subspecies retain their original characters. Even profound change of environment does not yield a new subspecific form, nor are changes of habit inherited in eight years of experiment.

(1) The summary of eight years' experiment proves the comparative stability of subspecies of the Deer-mice (Peromyscus) under very marked new environmental physical conditions. (2) Merriam-Osgood subspecies are proved to be stable under changed conditions of environment, by transplantation experiments; *i.e.* a desert subspecies, *P. m. sonoriensis*, reared for eight years in a humid environment, is entirely unmodified in the direction of the humid subspecies *P. m. gambeli*. (3) This doubly proves (*a*) that characters of the desert *P. m. sonoriensis* are germinal, not environmental; (*b*) that humid environment makes no modification whatever toward increased depth of colour in eight years and in seven to twelve generations. (4) Similar results from transplantation of *P. m. rubidus* and *P. m. sonoriensis* are obtained: reared in an entirely new environment, they do not converge toward each other but toward local humid species *P. m. gambeli*.

SPECIATION A SECULAR PHENOMENON.

Whereas an inheritable mutation may be produced by a single experiment, 40,000 years, the lapse of time since the last glaciation, is a moderate estimate of the time required to produce a subspecies. In the case of all the genera cited above—Cervus, Alces, Rangifer, Rana, Chalcides, Troglodytes, Peromyscus—we are observing subspecies arising in a region which was profoundly affected by the fourth glaciation with its pluvial climate, a region in which new subspecies have arisen *pari passu* with the modern demarcations of habitat and of habit. That speciation is an incredibly slow process is attested by the case of the newly discovered Pliohippus of Leidy, which early in Pliocene time assumed all the characters of the modern Equus. The entire speciation process of plants and animals has been going on perhaps for a thousand million years, as estimated on purely physical grounds, and in a recent conversation with Sir Ernest Rutherford it was agreed that another thousand years of research may be required for an understanding of the highly complex physico-chemical basis of life.

CONCORDANT OBSERVATIONS IN ZOOLOGY AND PALÆONTOLOGY.

As distinguished from the speciation observed in zoology, in palæontology we deal with secular speciation, in which, quoting from the first of Osborn's series of

papers on the origin of species, we observe the adaptive action and reaction of the heredity germ over long periods of time. We also observe the secular action of natural selection (Darwin's selection factor), the secular direct reaction to environment (Buffon's factor), the secular adaptive action of habit (Lamarck's factor), the secular adaptive reaction to the living environment (Darwin's factor). We sharply separate Darwin's factor of selection, which has no energy content, from the above four energetic forces of evolution, namely, heredity, physical environment, living environment, and individual development or ontogeny. This is the principle of tetraplasy and tetrakinesis.

This momentary lapse into speculative as distinguished from purely observational consideration of the problem of the origin of species may clarify the transition from zoology to palæontology.

In palæontology an entirely new series of principles is discovered in speciation which are quite beyond the eye of the zoologist. Chief among these new principles is that dimly perceived by Darwin in the words 'analogous variation'; it is that of germinal or evolutionary trend in a definite direction, the 'mutations richtung' of Neumayr. Out of this springs Osborn's principle of *rectigradation* observed in the rise of adaptive characters from the germ-plasm, that is, new specific characters which pass continuously from the most rudimentary and inefficient into the most efficient and highly developed stages. It may be a matter of interest to members of the British Association to recall that this principle was presented to the Association in 1889 by the present speaker. Through unbroken observation during the intervening thirty-seven years this rectigradation principle has been confirmed in four great orders of hoofed mammals, namely, the horses, the rhinoceroses, the titanotheres, and the proboscideans. Research on the two latter groups fills two great monographs aggregating nearly a million words and covering, in the case of the Proboscidea, the analysis of the mode of origin of more than 350 species and, in the case of the titanotheres, the chief stages of specific development extending from Lower Eocene through Lower Oligocene time, when these animals suddenly disappear.

An epitome of these observations is presented in three diagrams in which the three outstanding principles discovered in palæontology are observed: First, the unbroken continuity of speciation, which becomes absolute as the gaps are filled by discovery. Second, the constitutional predisposition to speciate in certain predetermined directions which must be inherent in the germ-plasm of ancestral forms. Third, that these constitutional predispositions are not released except through adaptive reaction to new conditions of life; they are not, therefore, of the nature of inherent perfecting tendency, but, rather, of the nature of a *potentiality* to appear when the need for them arises. For example, the rhinoceroses have the potentiality of developing two horns, an anterior horn on the nasal bone and a posterior horn on the frontal bone. But in the fourteen branches into which this great subfamily subdivides in its migrations to all parts of the earth, this double potentiality is seldom availed of, sometimes not availed of at all.

CONCLUSIONS.

We seem to have reached an entirely new era in research on the problem of the origin of species, marked by the decline and death of speculations and theories advanced upon the very limited knowledge of the first half of the nineteenth century. Through zoology and palæontology we have reached a solution of the least difficult half of the problem with which Charles Darwin was confronted: we know the *modes* by which subspecies and species originate; in fact, there is little more on this point to be known. But this very knowledge renders the problem of *causes* infinitely more difficult than it appeared to Darwin. The causes of 'variation,' to use the term he employed for the evolutionary process, lie in the way before us. They may be resolved or they may prove to be beyond human solution. We must resolutely face these alternatives, and in the meantime continue our synthesis over every field of biologic research.

The Geographical Distribution of Magnetic Observatories.

By Dr. C. CHREE, F.R.S.

THE provision for observational work in terrestrial magnetism is different in kind in different countries, and in some countries—Great Britain, for example—the provision made is of more than one kind. The object in view may be purely utilitarian, or purely scientific, or partly both. Originally the provision of information necessary for the use of the compass was the one utilitarian object generally recognised. To secure this object to the best advantage, the natural course is to make a single department responsible for the running of magnetic observatories, the taking of field observations and the preparation of charts. Thus, in the United States the Coast and Geodetic Survey controls the whole of official terrestrial magnetism. The number and position of the observatories—Sitka, Cheltenham, Tucson, Vieques (Porto Rico), and Honolulu—is determined primarily by survey considerations. The same idea prevailed to a certain extent in India, but the oldest magnetic observatory, Alibag—regarded as the continuation of Colaba, Bombay—represents a more usual form of development.

In most countries terrestrial magnetism has not been an independent plant, but from the point of view of astronomers and meteorologists has been a parasitical growth on astronomy or meteorology. Greenwich may perhaps be regarded as an example of this. At present most magnetic observatories are under the meteorological service of the country, and one of the two international associations concerned with the subject is the Magnetic Commission of the International Meteorological Committee. It is under its auspices that a selection of international quiet and disturbed days is made at De Bilt, Netherlands. The other international association, the Section of Terrestrial Magnetism and Electricity of the International

Union of Geodesy and Geophysics, represents the more distinctly scientific aspects of the subject. Its existence distinct from the Section of Meteorology is largely due to the independent position assigned to terrestrial magnetism in the United States and some other countries.

In France—as is still the case in Germany, Denmark, Holland, Belgium, and Portugal—terrestrial magnetism used to be in the main a branch of meteorology, but it now comes under the Institute of Geophysics, presided over by Prof. Maurain, of Paris. In Italy there was once an observatory at Rome under the Meteorological Office. But Rome—like Kew of later years—suffered from artificial disturbance and had to be given up, and Italy remained for many years without a continuously recording magnetic observatory. It succeeded after the War to the observatory maintained at Pola by the Austrian Admiralty, which is now controlled by the Italian Hydrographic Office.

Of the observatories independent of State control, the most important are those of the Jesuit Order and of the Carnegie Institution of Washington. The former group includes Stonyhurst—one of the oldest magnetic observatories now existing—Ebro (Tortosa) and Lukiapang (successor to Zi-ka-wei) in China. The Carnegie observatories at Watheroo (Western Australia) and Huancayo (Peru) are of recent creation.

In Bulletin, No. 5, 1924, of the International Section of Terrestrial Magnetism and Electricity, 66 magnetic observatories are included in the list on pp. 146-148, but some of these had not been active for some years, and a few, for example Kew, are now extinct. The number may seem large, but it means only one observatory per three million square miles of the earth's surface, while the diversity in the phenomena to be recorded is very great. Further, the distribution is very irregular. Of the 66 observatories mentioned above some 30 were in Europe, and only 13 were in the southern hemisphere. Only three were north of 60° N., and only two were south of 40° S. The regions of the globe in which observatories are particularly scarce call for our special consideration.

Until a few years ago Pavlovsk (59° 41′ N.) was the most northerly regular station provided with magnetographs. No publications from it or other Russian observatories for years after the commencement of the War were available until comparatively recently. But it would seem that unbroken records were obtained at Pavlovsk and Kasan in Russia, and at Ekaterinburg in Siberia. Records were also obtained at Irkutsk, or at Zuya in its neighbourhood, down to 1920. The Russians have also established a new station at Matochkin Shar (73° 15′ N.), in Nova Zembla, a neighbourhood where Prof. Birkeland had a temporary station in 1902–3. This is the most northerly station on the international list. From information recently supplied we learn that it is equipped with Eschenhagen magnetographs recording D, H, and V (declination, horizontal force and vertical force), the sensitiveness of these instruments being respectively 1′·0, 22·6γ and 5·7γ per mm. More suitable values for a station where H is very low and disturbance large, would be 2′ or 3′ per mm. for D, and 10γ for H and V. The magnetograph room itself seems to be of wood, but the instruments stand on a concrete and brick foundation. This foundation should be satisfactory if it is non-magnetic, a property, however, which is rather unusual in brick. Further, Russian observatories seem also in contemplation at Taschkent and in Eastern Siberia, a part of the world unrepresented at present.

Of the two other observatories on the international list north of 60° N., one, Sodankylä (67° 22′ N.), is run by the Finnish Government, which of late years has also been active in survey work. The third of the new high latitude stations, Lerwick (60° 9′ N.), in the Shetland Islands, was instituted by the Meteorological Office, and magnetographs were in operation in 1923. Another high latitude station of comparatively recent origin calling for notice is Meanook (54° 37′ N.) in Canada. This was only partially equipped in 1924, and one of the resolutions passed by the Section of Terrestrial Magnetism and Electricity at its meeting in that year at Madrid emphasised the importance of full equipment. Meanook is one of the nearest stations to the north magnetic pole. Yet another high latitude observatory is being instituted by the Danish Government at Godhavn (69° 15′ N., 53° 14′ W.) in western Greenland. Pavilions for absolute observations and for magnetographs connected by a corridor form a single building. An important feature is that the equipment includes two complete sets of magnetographs, one of low sensitiveness, so as to make provision for large disturbances.

Observatories in high magnetic latitudes (that is, latitudes where dip is high) have special difficulties to contend with. Magnetic disturbance is large, and H being small, changes in D are enormous, rendering ordinary D magnetographs unsuitable. On the other hand, small changes of dip represent such large changes of V that ordinary dip instruments are unequal to the satisfactory determination of base line values for V curves. It is thus a matter of general interest that the National Physical Laboratory has under construction an instrument for measuring V directly. The desirability of such an instrument was also the subject of a resolution at Madrid. High latitude stations are of special importance, not merely because they record magnetic disturbances in the regions where these are most developed, but also on account of the light they may throw on the relation between magnetic and auroral phenomena. The importance of this relation has been increased by the development of radio, and the evidence that has recently been obtained as to the influence on radio of a 'conducting layer' at about the height which Prof. Störmer has found for the lower level of aurora. So far at least as latitude is concerned, Lerwick should be favourably situated for combined observations on terrestrial magnetism and aurora. But the full utilisation of the opportunities presented by such a station calls not merely for special knowledge and equipment, but also for an ample and vigorous staff, as a lot of night work is involved under probably severe climatic conditions.

Another region where magnetic observatories have hitherto been sparse includes the geographical equator. The international list contains no station between Buitenzorg (Batavia, 6° 11′ S.) and Kodaikanal (10° 14′ N.), and a footnote supplies the regrettable information that Kodaikanal stopped recording in

1923. This will leave more than 20° of latitude unrepresented between Batavia and Antipolo (14° 36′ N.). Kodaikanal was one of the stations supported by the Indian Survey, which has also closed down observatories at Barrackpore (22° 46′ N.) and Toungoo (18° 56′ N.), thus leaving only two magnetic observatories, Alibag and Dehra Dun, in the whole Indian empire. The fact that, as compared with pre-War times, magnetic observatories have fared worse in India than in Russia seems to afford food for reflection. If Kodaikanal is an unsuitable site, as is rather suggested by remarks in some of the Indian Survey publications, the resuscitation of Trivandrum, memorable for the work of J. A. Broun, would provide a station nearer to the equator than any existing observatory in the northern hemisphere.

Other areas within the British Empire where magnetism is somewhat poorly represented are South Africa and Australia. There was once a magnetic observatory at Cape Town, and a new observatory somewhere else in South Africa has been talked about, but at present the Royal Alfred Observatory in Mauritius seems to be the only one in that part of the world. Melbourne was once the site of a magnetic observatory, but has long been unsuitable for that purpose. Recently an observatory has been set agoing at Toolangi in Victoria, but that seems the only observatory in Australia, with the exception of Watheroo, which belongs to the Carnegie Institution of Washington.

New Zealand has a magnetic observatory at Christchurch, and with assistance from the Admiralty and the Carnegie Institution is also maintaining what was originally a German observatory at Apia, Samoa. It is scarcely necessary to say, in view of the scarcity of magnetic observatories in or near the Pacific Ocean, that the stoppage of Apia observatory would have been a great misfortune.

The latest observatory of the Carnegie Institution, Huancayo (12° 3′ S.), is in a way unique from its proximity to the magnetic equator. Dip there at present is less than 1°, and its measurement must present unusual features. Huancayo is situated, moreover, in a continent, South America, where additional magnetic observatories are badly wanted.

Obituary.

SIR WILLIAM RIDGEWAY.

WILLIAM RIDGEWAY, a son of the Rev. J. H. Ridgeway, of Ballydermot, King's County, was born in 1853; he had a brilliant career in Trinity College, Dublin, and later at Gonville and Caius College, Cambridge, graduating as fifth Classic in 1880, and was elected a fellow of his College. In 1883 he was appointed to the chair of Greek in Queen's College, Cork, and while holding that appointment he resided for five months each year in Cambridge. In 1892 he was elected to the Disney professorship of archæology in Cambridge, and shortly afterwards resigned his chair at Cork. He was re-elected a fellow of his College, and had also been Brereton reader in classics since 1907. He was Gifford lecturer in natural religion, University of Aberdeen, in 1909–11; Stokes lecturer in Irish archæology, Dublin, 1909; and Hermione lecturer in art, Dublin, 1911. He was president of the Royal Anthropological Institute, 1908–10; of the Anthropological Section of the British Association, 1908; and had been president of the Cambridge Philological, Antiquarian, Classical and Anthropological Societies. He was elected a fellow of the British Academy in 1904, and was a foreign member of various learned societies in Europe. His learning was recognised by other universities, and he had conferred on him Hon. D.Litt. Dublin, 1902; Hon. D.Litt. Manchester, 1906; Hon. LL.D. Aberdeen, 1908; and gained the Sc.D. of Cambridge for his work on the horse. He was knighted in 1919. He wrote numerous contributions to classical, philological, anthropological, zoological and other journals, and the following books: "Origin of Metallic Currency and Weight Standards," 1892; "The Early Age of Greece," 1901; "The Origin and Influence of the Thoroughbred Horse," 1905; "The Origin of Tragedy," 1910.

This bare enumeration of the academic distinctions and of the writings of Sir William Ridgeway will serve to show the wide extent of his erudition and the great range of his interests. These were constantly exhibited when he joined in discussions at classical and scientific societies, in which he usually gave a free rein to his sense of humour, and also to caustic criticism. His strong personality and the definite views he expressed vividly in speech and writing, combined with his love of controversy, sometimes strained the forbearance of many friends, even occasionally to the breaking point. He was a man of pronounced likes and dislikes, and it was often a moot point whether he was not as dangerous to the causes he espoused and to his friends as to his enemies, for he was liable through friendly enthusiasm to overstate the case at issue. He entered wholeheartedly into a fray, whether it was Irish education, the Irish and English Anglican Church, or University politics, as those can testify who remember the discussions on the degrees for women and on compulsory Greek in the University of Cambridge.

Sir William was emphatically a driving force in the University, and spared no pains in furthering the well-being of the institutions to which he belonged, to take but two examples: the Cambridge Antiquarian Society and the Museum of Archæology and Ethnology. It was due to his energy that a lectureship in ethnology was instituted, and again largely to him that nine years later it was converted into a readership; in this and other ways he was instrumental in founding the Cambridge School of Anthropology. He very early recognised the value of ethnology in elucidating obscure points in classics and archæology; in some respects he was a pioneer in these comparative studies, and he delighted to recall how his heterodox views later gained acceptance from more conservative scholars.

Sir William stimulated very many students, naturally mainly in classical archæology, of whom a considerable proportion have gained great eminence, and he was careful to keep in frequent correspondence with them; but he also had a large number of correspondents throughout the world on an amazing variety of

subjects, from Asiatic ritual dances to currency and zebras.

Those who were privileged to see Sir William's family life gained another view of this very remarkable man. His love for his wife was as apparent as it was deserved, for Lady Ridgeway devoted her life to her brilliant husband, and no one will ever know what he owed to her. She was his prop for very many years as his eyesight increasingly failed, and she dispensed gracious hospitality to his friends in their charming home at Fen Ditton. Her sudden death at the end of May was a terrible blow, and though he gallantly tried to overcome his desolation and to take up the threads of his old life, he was a broken man until death mercifully took him in his sleep during the night of August 11: a peaceful ending for a strenuous and militant life.

A. C. HADDON.

WE regret to announce the following deaths:

Mr. William Fawcett, lately Director of Public Gardens and Plantations, Jamaica, on August 14, aged seventy-five years

Prof. Robert Gnehm, professor of technical chemistry, and afterwards director of the Technical High School, Zurich, who was known for his investigations on dyeing processes and dyestuffs, aged seventy-four years.

Dr. J. F. Hall-Edwards, president of the British Electro-Therapeutic Society, and a pioneer in the field of medical radiology, on August 15, aged sixty-seven years.

News and Views.

THE meeting of the British Association at Oxford which ended on August 11 has been memorable in many ways; and not least for the specially interesting character of the proceedings at the concluding gathering held at the Examination Schools. The message received from the Prince of Wales as president summed up in felicitous language the aims and prospects of the cause of science, the advancement of which it is the object of the Association to promote. The message also conveyed, in graceful terms, the president's appreciation of, and thanks for, the efforts made by all concerned to render the Oxford meeting of 1926 one of the most successful in the records of the Association. The reply read by Sir Oliver Lodge as chairman gave due expression to the gratitude felt by the members assembled at Oxford for the keen personal interest and sympathy shown by the Prince in the work of the Association, notably in his inaugural address.

THE speech delivered by Sir Oliver Lodge bore eloquent testimony to the world-wide charm exercised by Oxford over all who can be touched by the long history of western civilisation and culture. The well-known eulogy by Matthew Arnold, marked by graceful fancy and poetic feeling, and not without a light suggestion of penetrating humour, came with especial force and acceptance from one so capable of giving it its full effect as Sir Oliver Lodge. The significance of the presence of guests from overseas and from foreign countries had been emphasised by the Prince in his message, and was driven further home by the chairman of the meeting. The speeches of Prof. M'Murrich and Prof. Osborn, the latter of which concluded the meeting, showed that they too, as visitors and guests from overseas and abroad, fully appreciated the claim of science for international co-operation and fellowship The final meeting at the schools was especially well attended, and formed an excellent conclusion to a very successful gathering.

AMONG several interesting papers presented to the Chemistry Section of the British Association at Oxford was a contribution by Mr. J. J. Manley on "The Union of Mercury and Helium." Judging by a lengthy report of Mr. Manley's paper in the *Times* for August 11, the author does not appear to have carried his investigations beyond the stage described in his letter to NATURE of April 24 last, except that he now believes that only one helide --HgHe—is formed, whereas in the letter he stated that he had obtained experimental evidence of the existence of two—$HgHe_{10}$ and HgHe. The evidence for union appears to be based upon the disappearance of free helium when it is submitted to the action of the electric glow discharge in contact with purified mercury, and upon a slight increase in refractive index as the action proceeds. The presumed compound is apparently decomposed by heat, so that its composition could be deduced from the difference in weight of 'uncombined' mercury before and after the experiment. As this difference is exceedingly small—of the order of 236 millionths of a gram—it is clear that Mr Manley is encountering very great experimental difficulties, and bearing in mind the somewhat similar work of Miethe and Stammreich on the alleged transmutation of mercury into gold (NATURE, May 29, 1926), it is obvious that further investigation is required to dissipate or confirm the doubts that are held concerning the author's conclusions. Should those doubts be dissipated, Mr. Manley's work will constitute a discovery of very great importance.

IN the issue of the *Times* referred to, a leader-writer refers to Mr. Manley's contribution as a "startling announcement," as if it were novel, but actually the claim was first announced by Mr. Manley in these columns more than twenty months ago (NATURE, December 13, 1924). It is perhaps asking too much to expect a leader-writer, even in the *Times*, to be conversant with all that appears in our correspondence columns, but the incident directs attention once more to the need of adequate scientific representation on the staffs of our leading newspapers, and it also testifies to the value of the work done by the British Association in affording opportunity for lay writers to proclaim from the house-tops matters

of scientific importance that otherwise may be lost in the pages of scientific periodicals. The opinion is frequently heard that announcements of great discoveries at meetings of the British Association are less frequent than of yore, and although there is little more valid evidence for this opinion than for that concerning the diminished severity of our winters compared with those of, say, fifty years ago, the belief is probably to some extent responsible for the unbridled romance with which the popular writer is apt to invest his accounts of scientific achievements. The first duty of the newspaper man is to make a 'story,' and to this end he gives free rein to his unscientific imagination by supplying or suggesting sensation where it is not called for, or by elaborating relatively unimportant details at the expense of the main issue; he is also peculiarly susceptible to the temptation of treating the new as of necessity true, and occasionally, as in the present instance, of treating the true as necessarily new.

A STRONG earthquake was felt in the midland and western counties of England and in Wales at 3.58 A.M. (G.M.T.) on Sunday, August 15. From the accounts so far received it appears that the shock was felt over a nearly circular area 225 miles in diameter, and containing, therefore, about 40,000 square miles. The centre of this area lies a few miles to the south-east of Hereford, and it is worthy of notice that the shock was strongest in this city and Ludlow and in some of the villages between. A few chimneys fell at some of these places, but damage slight would not entitle the earthquake to a higher degree of intensity than 7 of the Rossi-Forel scale. During the last forty years British earthquakes of the same intensity have disturbed areas ranging from 25,000 to 63,000 square miles. The position of the roughly determined centre suggests that the recent earthquake may be connected with the twin-centres in a northwest-southeast line near Hereford and Ross, which gave rise to the strong earthquakes of 1863, 1868, and 1896. These disturbed areas of about 85,000, 41,000, and 98,000 square miles respectively. As regards intensity and disturbed area, the recent earthquake closely resembles that of 1868, and it is not impossible that, as in that year, the Ross focus was mainly responsible for the disturbance. The much slighter shock of January 26, 1924, was not directly connected with the others, for the axis of its disturbed area runs in a northeast-southwest direction through or near the Hereford focus.

AFTER a busy professional life of forty-three years, Prof. T. Turner is retiring on September 30 from the Feeney chair of metallurgy in the University of Birmingham. Taking the Associateship of the Royal School of Mines with the De la Beche medal in 1883, Prof. Turner was appointed demonstrator in chemistry at Mason College. A few years later he became lecturer in metallurgy, and when the chair of metallurgy was instituted in the University, he was appointed professor and has held the position for nearly a quarter of a century. Prof. Turner's own research work has dealt with silicon in cast iron, the production of wrought iron and steel, the hardness of metals; volatility, density and other properties of metals and alloys. He is a past president of the Institute of Metals, having also served as treasurer. He is a member of council and Bessemer Gold Medallist of the Iron and Steel Institute. He is an honorary member of various metallurgical societies in the Dominions, the United States, and on the continent. In his own University, a gold medal has been instituted to commemorate his services to metallurgy. His best known book is the "Metallurgy of Iron," which has passed through several editions.

THE School of Research in Metallurgy at the University of Birmingham, under the able guidance of Prof. Turner, has done much original work, and has contributed in no small degree to the amazing progress in metallurgical science which has taken place during the present century. The past and present students and friends of the metallurgical department of the University and of its retiring professor, have decided to make a presentation to him in the immediate future. The subscription list is open to all who feel inclined to associate themselves with the movement; members of the local section of the Institute of Metals and of the Birmingham Metallurgical Society are supporting the scheme. Several local firms have also intimated their desire to subscribe. Further information and subscription forms may be obtained on application to Dr. T. B. Crow, hon. sec. to the testimonial committee, at the University, Edgbaston, Birmingham. Prof. Turner is proposing to reside at Leatherhead, Surrey, in order to keep in close touch with his interests in London, and in extending to him and Mrs. Turner our best wishes for further years of health and happiness, we will be voicing the sentiments of his very large circle of friends.

ALL true lovers of plant life will be interested to hear of the exceptionally well thought-out scheme propounded by Dr. L. Cockayne, the doyen of New Zealand botanists, for the setting apart of the Wilton's Bush Reserve, about three miles from the capital city of Wellington, N.Z., as an "open-air museum for plants native to New Zealand." The New Zealand flora is unique, not only in the beauty of its forests, its ferns and its alpine associations, but also in certain aspects of the lines of evolution which it has undergone, such as, for example, the replacement of a xerophytic type of foliage in the young plants of a number of species by a mesophytic type when well grown, this being exactly the opposite to what happens in the well-known case of the Australian phyllodineous wattles. Dr Cockayne propounds a scheme with four main points in it, as follows:—(1) A well-grown collection of all possible species from the flora of New Zealand, the Kermadecs, Stewart Island, Chatham Islands and the subantarctic islands, so far as the limitations of the soil and climate of the proposed site will allow. (2) Representations of the leading plant-associations found in the Dominion, just as they existed in primeval New Zealand. Many of these associations are now either almost extinct or very inaccessible for study, and this scheme would

bring them within reach of students in the capital city. (3) Illustrations of the horticultural use that can be made of New Zealand plants, by the planting out of small gardens, alpine rockeries, etc. (4) Restoration of the present forest area of Wilton's Bush to its primeval condition. The area is already much modified and invaded by exotic weeds, but could speedily be brought back to its original state by scientific treatment.

DR. COCKAYNE suggests that the plan should be put into operation gradually over a number of years, and that a start could be made at once by procuring from all parts of the Dominion the plants required to build up the complete collection of the flora, and in particular by concentrating on the formation of an alpine garden along the sides of the mountain stream which flows through the bush. He also suggests the transformation of one of the fine cliffs in the gully into a representation of the typical cliff flora of Eastern Marlborough, which is one of the most striking plant associations known in New Zealand. After that the planting of a small kauri forest could be taken in hand, and so, from year to year, one new effect after another could be added until the scheme was completed. The scheme as outlined (*vide* the *Dominion*, Wellington, June 15) appears to us to be a very fine one, and will certainly meet with the cordial support and approval of botanists throughout the world. We hope that the Wellington City Council will take a wide view of the problem and not allow considerations of finance to stunt a plan which, if carried out in a broad and generous spirit, will add greatly to the fame of a capital which at present is perhaps too much renowned for its windiness and too little known for its wonderful beauty.

A PUBLIC demonstration of the potato trials carried out by the National Institute of Agricultural Botany at its Potato-Testing Station at Ormskirk took place on August 11. Research into the resistance of potatoes to wart disease (*Synchitrium endobioticum*), undertaken by the Institute on behalf of the Ministry of Agriculture, forms a large part of the work. Wart disease is fortunately not spreading, but there is an urgent demand from infected districts for improved immune varieties. New productions of breeders are grown by the Institute at Ormskirk in highly infected soil to determine their reaction to the disease. A variety is only certified as immune if it has been grown for at least two years at Ormskirk without showing any trace of disease. Dry seasons do not afford a good test, and therefore occasionally three or even four seasons are required. This year 97 stocks are being tested for the first time, 45 for the second, and 9 for the third. There are also 626 stocks of from two to ten tubers each, which are grown both to inform breeders at the earliest possible date which of their seedlings are susceptible, and to assist genetical studies on the inheritance of immunity. It is of interest to note that it is theoretically possible to find an immune variety as a parent which will produce 100 per cent. immune seedlings, no matter what the other parent is. Research is also made on the methods of transmission of virus diseases, such as leaf-roll and mosaic, which are a serious menace to English potato crops. There appears to be some correlation between the health of the crop from which the seed-tubers are taken and the incidence of these diseases in the following year. On the other hand, the diseases apparently cannot be transmitted through the soil or by mere contact of foliage. Trials are also being made both of the chief main crop varieties and of the best new immunes to determine their yielding capacity and the time taken to mature. The improvement of the methods of testing these characters is also under investigation. Finally, all stocks sent to Ormskirk as new are examined by the Institute's Potato Synonym Committee; 1533 stocks were reviewed between 1920 and 1925. In 1920 72 per cent. proved to be 'synonymous,' but by 1925 this unsatisfactory proportion had been reduced to 16 per cent. of the entries, the remaining 84 per cent. being distinct varieties.

A FOURTH edition of the handbook entitled "Particulars of Meteorological Reports issued by Wireless Telegraphy in Great Britain and the Countries of Europe and North Africa" (M.O. 252) has been issued by the Meteorological Office, Air Ministry (London: H.M. Stationery Office, price 4s. net). It contains full particulars of the meteorological bulletins issued by the various countries. These bulletins are normally issued at least three times a day, and include ordinary ground observations of weather, wind, temperature, humidity, and height of the barometer for a number of places. They also include information about conditions in the upper air, reports from and to ships at sea, and weather forecasts. Full particulars are given of the various codes in use for summarising this information. The area dealt with extends westwards to America, eastwards to Siberia, northwards to Spitsbergen, and southwards to northern Africa. Greenland is also now included. Changes constantly occur in the weather reports issued by radio from different countries, and in order to keep those interested informed of such changes, supplements to this handbook are issued from time to time. This revised fourth edition embodies all supplements issued since the previous edition. The area covered by the weather charts prepared from these messages is shown in a frontispiece. Most of the issues can be received in the British Isles by the use of quite modest receiving apparatus. Purchasers of this work will be informed when amending notices are issued and when a new edition is ready if they notify the Director of the Meteorological Office of their desire to receive this information.

No one can work in the vast field of economic and political science or be engaged in business or trade, without continually feeling the need of some work which will supply in a handy form statistical and other information on any of the numerous topics that go to make up the complexity of modern life.

It is well known that such works—encyclopædias, year-books, professional and trade directories, commercial returns, biographies, and so on—are published in large numbers in all parts of the world and relating to diverse subjects, but it is not always so easy to obtain definite information of their exact nature or to make the most suitable selection to meet any particular want. Dr. Paul Heile has now set out to provide a guide to this wealth of material in his "Nachschlagebuch der Nachschlagewerke für die Wirtschaftspraxis" (Hamburg: Verlag Wirtschaftsdienst G.m.b.H., 5 marks), which he has compiled, using as a basis the collection of the Welt-Wirtschafts-Archiv at Hamburg after a special attempt had been made to make this as representative as possible. The work is comprehensive and is divided into the following sections: general, geographical, commercial substances, directories (again subdivided geographically and by subject), dictionaries, and biography. German works predominate, as is natural, but the other countries are well represented, as a glance at the geographical section shows, and the value of the work is enhanced by annotations where the title is not self-explanatory and by analysis of those entries which cover more than one subject. It is a drawback to its use as a reference book that such details as place of publication and publisher's names have not been given, but it will nevertheless be a valuable guide for business firms in Great Britain and for our growing commercial libraries. The volume contains also a classified list of the 1000 or so current trade and commercial periodicals taken by the library at Hamburg, together with a history of the Institute. The receipt of the work makes us hope that the promised catalogue of the Library of the London School of Economics will not long be delayed.

THE Annual Report of the Mines Branch (Canadian Department of Mines), for 1924 contains a section on investigation of fuels and fuel testing, which throws light on the fuel problem as it occurs in Canada. Experiments are recorded on the production of coke from the coal of the Maritime Provinces. The coke is intended to make Canada independent of imported anthracite. Tests of friability of coke have been worked out. Reports are made of lubricating oils and gasoline marketed in Canada. The distillation of lignite and sub-bituminous coal and oil shale is considered, evidently an anticipation of the time when supplies of liquid fuel will have to be produced at home.

A BIBLIOGRAPHY of meteorological literature prepared by the Royal Meteorological Society with the collaboration of the Meteorological Office (No. 9, January-June 1925) has recently been issued by the Royal Meteorological Society. Since October 1920 the bibliography which previously had been given in the Society's *Quarterly Journal* has been issued as a separate publication in six-monthly parts (price to non-fellows, 2*s*. 6*d*.). A symbol is attached to the title of the work to show in which library the publication has been received. The divisions of the bibliography deal with general meteorology and with various branches of the work, such as temperature, rainfall, and terrestrial magnetism. The publication is helpful to meteorologists in different parts of the world.

THE annual report of the Physical Department of the Ministry of Public Works, Egypt, for 1923–24, has been issued. Dr. H. E. Hurst, the controller, reports continued progress in all departments. In the hydrological service observations are now obtained from 286 rainfall stations, an increase of five on the previous year, and from 82 gauging stations extending from Egypt to Uganda, Kenya and Abyssinia. The daily weather report continues to be published, based on the data from 28 stations in Egypt and the Sudan, five in Europe and two in Palestine. A daily broadcast message is sent out from Abu Zabal at 09·55 G.M.T. Upper-air investigations by pilot balloons from Helwan Observatory continue. Arrears of meteorological publications which accumulated during the War are being fast overtaken, the annual reports up to 1921 being nearly ready. The report contains a full list of the publications of the department.

VOLUME 17 of contributions from the Jefferson and the Cruft Laboratories of Harvard University consists of reprints of thirty-nine papers on physical subjects which have been published in scientific periodicals during the years 1924–5. Nine of these emanate from the X-ray laboratory of Prof. Duane, six from that of Prof. Bridgman, four deal with radio circuits and their properties, and twelve with spectroscopy. In the last group is a paper by Messrs. H. N. Russell and F. A. Saunders directing attention to certain new regularities in the spectra of calcium, strontium, and barium. Almost the whole of the lines of the first two are now identified by the help of new spectroscopic terms comparable in importance with the older terms, but some of them negative. The authors characterise the present notation of spectroscopy as chaotic, and as the result of discussion with other workers suggest that in future the *series* be denoted by Roman capitals, the *system* by an index at the upper left hand giving the multiplicity, and the *component* of a multiple term by a subscript on the right giving the inner quantum number.

READERS interested in early printing should obtain from Messrs. Bowes and Bowes, 1 Trinity Street, Cambridge, a copy of their Catalogue (No. 435) of books printed from 1477 to 1600. The list comprises some 548 titles, to which are added many helpful notes.

THE British Science Guild will publish shortly a Supplement to its Catalogue of British Scientific and Technical Books. The Supplement has been compiled by Miss Daphne Shaw from the monthly lists published in NATURE, and it will contain 2258 titles of books issued in 1925, classified alphabetically from agriculture to zoology, as well as an author index.

MESSRS. Chapman and Hall, Ltd., ask us to state that they have had in active preparation "The Theory and Practice of Radiology," by Dr. B. Leggett, but

that in consequence of a fire at their printers the whole work, almost completed, was destroyed, and it is therefore necessary to recommence production and there will be a delay of some months in the publication of the volume.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A junior inspector of mines in the Mines Inspectorate of the Government of India—The Secretary to the High Commissioner for India, 42 Grosvenor Gardens, S.W.1 (August 30). Assistant masters for, respectively, physics and mathematics and chemistry, and physiology and biology at the Lawrence College, Ghora Gall (Murrer Hills), India—The Principal, St. Luke's College, Exeter (August 31). An adviser in dairy bacteriology at Armstrong College, Newcastle-upon-Tyne—The Registrar (September 2). An assistant bacteriologist in the Department of Pathology and Bacteriology of the University of Sheffield—The Registrar (September 11). A lecturer in plant physiology in the University of Aberdeen—The Secretary (September 14). A senior metallurgist under the British Cast Iron Research Association—The Director, 75 New Street, Birmingham (September 15). A professor of philosophy in the University of Sydney—The Agent-General for New South Wales, Australia House, Strand, W.C.2 (September 15). A professor of psychiatry in the University of Sydney—The Agent General for New South Wales, Australia House, Strand, W.C.2 (September 15). A research bio-chemist at the Walter and Eliza Hall Institute of Research, Melbourne—The Agent-General for Victoria, Victoria House, Melbourne Place, Strand, W.C.2 (September 30). An adviser in agricultural chemistry at Armstrong College, Newcastle-upon-Tyne—The Registrar (October 1). A lecturer in mathematics and physics in the Government College for Indian Women, Lahore—Miss G. Harrison, The Poplars, Buckingham.

Our Astronomical Column.

THE AUGUST PERSEIDS OF 1926.—Mr. W. F. Denning writes that "a series of very clear nights during the first eleven days of August enabled these meteors to be well traced as they gradually increased to a maximum on the morning of August 12. On August 7 the shower was strikingly evident by some fine, flashing meteors. The hourly number observed was about twenty-five from all radiants, of which the proportion from Perseus was sixteen. On August 10, after rain and clouds had prevailed in the early part of the night, the sky became very clear and 60 meteors were seen by an assistant during a watch maintained for $2\frac{1}{2}$ hours. The great majority of these were Perseids and were fairly bright with the normal features of swiftness and afterglows, the latter being strongly marked in several cases where the heads were unusually lustrous. On August 11 clouds and rain again affected the conditions, but soon after 22^h G.M.T. the sky became clear and the ensuing morning presented an ideal aspect for astronomical purposes. A look-out was maintained for $4\frac{1}{2}$ hours and 180 meteors were counted. About 145 of these were Perseids and included a fair proportion of conspicuous objects with long paths and a rapidity of movement which called for celerity on the part of the observer in accurately recording their flights. The maximum of the shower occurred between 2^h and 3^h G.M.T., August 12, when 60 meteors appeared. On the whole, however, the display may be regarded as only of moderate intensity and not nearly so rich in number as those of 1871, 1874, 1877, 1921 or some other years."

SOLAR RADIATION.—Special attention is directed by the Scientific News Service of the Smithsonian Institution to a recent issue of the *Monthly Weather Review* of the U.S. Weather Bureau, which is said to contain a further corroboration by Dr. Abbot of the reality of the variability of the sun's radiation. From a series of observations made at Mt. Wilson by himself and Mr. L. B. Aldrich during the years 1910–1920, a selection has been made of the days on which the atmospheric conditions were as nearly identical as possible, these being divided into comparable groups. Observations made throughout 1912 and 1913 were discarded on account of the Mt. Katmai eruption. When the mean values of the solar radiation readings for these selected days, grouped for a month at a time (the mean value for July of each year from 1910–1920 is given as an example), are plotted, together with the solar constant values already published by the Smithsonian Institution and the sunspot numbers for the same epochs, a close degree of parallelism is shown between the three sets of observations. It is also claimed that short interval changes within the individual months are verified. It is not stated, however, whether the data for other months or periods of the year give as close agreement as that shown for July. The full details of Dr. Abbot's communication will be awaited with interest.

THE SYSTEM OF CASTOR.—This beautiful system became still more interesting when Adams and Joy found in 1920 that the distant companion C (about 1′ distant from the bright pair) was itself a spectroscopic binary. The period was at first given as 4 days, corrected later to 0.815 days. C is of magnitude 9.03; as the two spectra are of equal intensity, each component is of mag. 9.78; taking the parallax as 0.0747″, this corresponds to absolute mag. 9.15.

Mr. H. van Gent, of Leyden Observatory, examined C for variability and found that it is an eclipsing binary. He has determined the light curve from photographs taken with the Leyden 33 cm. refractor. He discusses the observations in *Bull. Astr. Inst. Netherlands*, vol. 3, No. 97. The radius of each component is 406,000 km.; the mass of each is 0.518 sun and density 2.60 sun; the distance apart 2,581,000 km. and inclination 86°.

The surface brightness of each component is 3.31 mag. fainter than that of the sun. The effective temperature is deduced as 3500°, agreeing well with the spectral type *M*. These exact details concerning a red dwarf star are of great interest.

It is noted that Castor C has the greatest parallax and proper motion so far known among eclipsing variable stars, and that the components of 61 Cygni have similar absolute magnitude and colour.

Research Items.

THE HUNGARIAN BRONZE AGE.—In *Man* for August, Dr. Lajos Zoltai describes two bronze hoards from Hajdusámson, near Debreczen. The finest examples of the Hungarian bronze industry come from the region known as the Nyirség in the north-east bend of the Tisza, which would appear to have been densely populated and a centre of culture in the Bronze Age. The hoards here described are now in the City Museum of Debreczen. The first consists of a sword and twelve axes found in an orderly grouping which suggests a votive deposit. The leaf-shaped sword is only 53·2 cm. long and has a pommel of which the button consists of closely fitting superimposed rhombs, diminishing in area from the base, the smallest being pointed. Such a pommel is unique in Hungary but is met in Scandinavian swords. Analogous forms of sword are figured by Montelius from north Germany and north Italy. The scroll decoration of the blade is peculiar to Hungary. Three of the axes are similarly decorated. Hajdusámson lies near the centre of the region in which axes ornamented with this scroll pattern are found. It may be described as the centre of the area of fabrication. The second hoard consisted of a number of bronze vessels of which the peculiarity lay in the double handles and their mode of attachment. Mr. Gordon Childe, in an appended note discussing the chronology of the finds, points out that they illustrate two periods of the Hungarian Bronze Age. The leaf-shaped sword belongs to the earliest variety and, being stamped clearly with marks of local manufacture, supplies a link missing in Peake's argument for the Hungarian origin of the type.

PHYSICAL CHARACTERS OF THE FRANKS.—A detailed study of skeletal remains from a Franco-Merovingian cemetery at Baye (Marne) by M. H. V. Vallois in Fasc. 4-5-6, Vol. 6, VII^e Série of the *Bull Soc. d'Anthropologie de Paris*, concludes with a comparative study of such material relating to these invaders of France as is available. The typical Franks would appear to be comparable to the tall dolichocephals of the *Reihengräber*. The type is found with some frequency in Flanders, but in France it rapidly merges into the rest of the population. Thus the Frankish cemeteries of the centre and east of France show a fairly homogenous population in which the skeletal characters agree, generally, with those of the Franks of Belgium, in being dolicho- or sub-dolichocephalic, mesoseme, mesorrhine, or leptorrhine, to some extent prognathous and with a marked protuberance of the occiput. But in the south of Belgium and the more central parts of France these characters rapidly undergo progressive modification, dolichocephaly becomes sub-dolichocephaly, leptorrhiny, mesorrhiny, and the effect of crossing with the Gallo-Roman populations is more and more marked as the distance from the Frankish centre of origin increases. The decrease in stature is considerable, and the measurements given here, 1·64-1·67 m. (males), 1·53-1·58 m. (females), while higher than those of the neolithic peoples, do not exceed those of the Gauls or medieval or modern Parisians. It is noted that while the early crania are predominantly dolichocephalic, and brachycephals are rare, the face being long and narrow of the typical Nordic character, in the cemeteries of Normandy by Merovingian times the dolichocephals are becoming more rare and are mixed with brachycephals, and by the tenth and eleventh centuries the brachycephals are almost the only type, showing that by then the original Gallo-Roman population had resumed preponderance. Yet it is remarkable that while the tall stature and leptorrhiny disappeared almost at once, dolichocephaly, prognathism and the protuberance in the occipital region persist for a much greater length of time.

MODERN WHEAT BREEDING.—The aim and present position of modern wheat breeding is outlined by Sir Rowland Biffen and F. L. Engledow in *Research Monograph* No. 4 of the Ministry of Agriculture and Fisheries. So far as possible the account is couched in non-technical language to render it intelligible to farmers and other non-academic readers, and it presents a clear and concise picture of the methods adopted and the results attained. After a general statement of the problem the principles of heredity and various theories bearing thereon are discussed, together with the complications associated with linkage, chromosomes, races and species. Breeding may be for increased yield or better quality of grain, for greater resistance to disease or for straw less liable to lodging, and in each case specific methods have to be adopted. Increased strength of straw is a most important point, as in many cases farmers are afraid to cultivate in such a way as to obtain the maximum possible yield, for fear lest the crop should lodge and the expense of the extra cultivation and manuring be lost without adequate return. The process of breeding new cereals is necessarily slow, since, owing to the rigid tests that are needed for purity for milling and baking, about ten years must elapse before any promising new variety can be placed on the market. The need in British farming is for a strong wheat with good yielding capacity, and in 1916, Yeoman wheat was introduced to meet these demands so far as possible. After several years' further experiments a still better wheat has been produced, known as Yeoman II., and it now remains to be seen whether this will fulfil its promise under ordinary methods of general cultivation.

HERRING, MACKEREL, AND PLANKTON.—Many naturalists have expressed the belief that movements or occurrences of herring and mackerel at certain seasons are influenced by the presence or absence of certain planktonic organisms. If this is so, then fishermen might benefit greatly by an instrument which would give them a quick indication of the state of the water in which they were proposing to fish. An instrument for use on commercial fishing craft must, however, be simple, strong, easily handled and rapid to use. In his paper, entitled "The Herring in Relation to its Animate Environment," Part 2 (Min. Agric. and Fish., Fishery Investigations, Ser. 2, Vol. 8, No. 7. London, H.M.S.O., 1925), Mr. A. C. Hardy describes trials of his 'plankton recorder,' which consists essentially of a cylinder carrying a white gauze filtering-disc. When the instrument is towed end-on through the water, plankton is deposited on the disc, imparting to the latter a distinctive colour which is dependent on the nature and number of the plankton organisms present. Discs used from commercial drifters in 1922 and 1923 during the herring fishery in the North Sea, and the south-west mackerel fishery from Newlyn, strongly suggested that poor fishing occurred in waters which gave a green disc (due to the predominance of Diatomacea or Phaeocystis). On the other hand, no very convincing correlation could be demonstrated between the number of copepods (red, pink or yellowish-pink disc) and the quantity of fish caught. Confirmation of the results of these preliminary trials is needed, and much interesting and useful information may be expected from an extensive use of this plankton recorder.

FISHERIES INVESTIGATIONS IN DENMARK.—The report of the Danish Biological Station for 1925 covers a wide range of work. Dr. Petersen, in a short discussion on the influence of fishing upon the stock of plaice in the Baltic, gives figures, based on official statistics of landings, which show that since the War there has been a steady decrease in the annual yield of plaice in that region. He suggests that the time has come for a suitable protection of plaice in the Belt sea, and, if possible, by the aid of international legislation, also in the Kattegat and certain parts of the Baltic. A report on the estimation of the density of oyster-population in the Limfjord gives instructive data of collections made by divers. In 1907 the density was estimated to be 1 oyster for each 3·2 square metres, but in 1924 it had dropped to only 1 oyster for each 38 square metres—a reduction to $\frac{1}{12}$. In addition to living oysters, the diver collected the shells of dead individuals. The shells of oysters which had died since the previous summer were easily recognisable, and thus an estimate could be made of the mortality during the season 1923–1924. An alarmingly heavy death-rate of 71 per cent. of the stock was indicated for the hard bottom area in the western parts of the Broad of Livo. Dr. Blegvad gives an account of his continued studies on the quantity of fish-food in the sea bottom, by means of the Petersen bottom sampler, and the detailed examination of the stomach contents of fishes. He attributes the considerable variations in quantity of food for fishes, from year to year, to (1) good brood years of the chief food species, alternating with bad years; (2) the consumption by fishes and other predatory animals, although the effect of the consumption by fishes has probably been exaggerated; (3) physical reasons, such as cold and lack of oxygen, which often kill off large numbers of food animals, especially during the winter.

FERTILITY IN THE DOMESTIC FOWL.—Dr. F. A. E. Crew gives (*Proc. R. Soc. Edin.*, vol. 46, pt. 2, 1926) the results of a series of experiments designed to determine the time of the onset of fertility in the domestic hen after the introduction of the male and the duration of fertility after his removal. He found that fertile eggs can be expected within 24-48 hours after the introduction of the male, though the onset of fertility varies with different matings. The length of life of the sperm within the body of the female is 15-20 days, but the eggs laid after the first week commonly fail to complete their development. If after the removal of the male a second male is introduced, the influence of the first sire is removed by the seventh-tenth day and there appears to be a relation between the general vigour of the male and the fertilising power of the sperm it produces. These results have an important practical bearing for the poultry farmer.

THE ANATOMY OF THE ELEPHANT.—Dr. N. B. Eales has made a careful and detailed dissection of the head of a fœtal elephant and has given an account of her results (*Trans. R. Soc. Edin.*, vol. 54, pt. 3, 1926) illustrated by twelve plates of beautifully clear and well-executed drawings. The work amplifies and corrects that of earlier workers and, as the specimen is unique, Dr. Eales has made the fullest possible use of it. The most interesting result obtained by the author is the evidence of ancestral history revealed by the characters of the lower jaw. The upper part of the skull is essentially like that of the adult and of all modern elephants, the differences being due to fœtal characters entirely. But the lower jaw exhibits the *longirostris* phase of the modern elephant's ancestry. It is relatively longer than in the adult, and the change to the adult condition is accompanied by a definite metamorphosis involving a relative shortening of the anterior part of the mandible. This interesting observation is of the utmost importance as corroborative evidence supporting the accepted facts of palæontology. Dr. Eales is to be congratulated on the completion of a distinguished piece of work.

CULTIVATION OF DROSOPHILA FOR LABORATORY PURPOSES.—Drosophila is now widely used as a laboratory animal especially in genetic investigations, and there is no reason why it should not be used extensively for class purposes to demonstrate the most important results of modern research in genetics, provided it can be kept successfully in the laboratory. With this end in view Prof. Raymond Pearl has investigated the possibilities of making a satisfactory synthetic food medium, free from the uncertainties of the standard banana medium now in use, which would give the required degree of quantitative precision desirable in genetical work. Such a medium is described in a recent paper by Prof. Pearl (*Journ. Gen. Physiol.*, March 1926, vol. 9, No. 4). It is an entirely artificial medium, containing no natural fruit juice and with a higher degree of acidity than the banana medium. On account of its high acidity there is practically never any contamination of the cultures by troublesome bacteria. Experiments with this medium have shown that it is greatly superior to the banana medium in respect of both the fertility and the mortality of the flies kept on it. These results should be of great service to laboratory workers and teachers who may wish to keep Drosophila for class purposes.

YIELD AND POSITION OF FIELD CROPS.—The effect of outside rows on the yields of kafir and milo crops has been determined by J. S. Cole and A. L. Hallsted in the United States over a period of eight years (*Jour. Agric. Research*, 32, 10). The outside rows of 10-row plots gave heavier yields than the inside rows except in 1915, a year of unusually low temperature and heavy rainfall. The increase was much greater in the yield of grain than of stover. On an 8-year average, the acre yield of kafir grain from the outside rows was 30 per cent. higher than that from the inside rows, but the stover was only 7·5 per cent. higher. With milo the figures were 43 per cent. excess grain and 8 per cent. excess stover in favour of the outside rows. The increased yield of grain from the latter proved to be roughly proportionate to the increased area of soil available to them. The relationship between the yields from all ten rows and the inside eight rows of each plot proved to be linear, the correlation being very nearly perfect, and consequently the relative merits of the methods represented could be equally well determined by either including or rejecting the outside rows. The yields determined from the entire 10 row plots were, however, subject to a systematic error arising from the fact that the effective areas of the plots were somewhat greater than the conventional areas assigned to them in converting the plot yields to acre yields.

A NEW SPHYGMO-MANOMETER.—Messrs. Hawksley and Sons, Ltd., 83 Wigmore Street, London, W. 1, have submitted to us for inspection a specimen of the 'Baumanometer' devised by Messrs. W. A. Baum and Co. Inc., New York, for the measurement of arterial blood pressure. The instrument is a modified form of the well-known mercury sphygmo-manometer. To justify the introduction of still another instrument

for measuring blood pressure the booklet supplied with the instrument finds two faults with the existing U-tube manometer, namely, the smallness and variability in the bore of the tube. It states that errors so great as 20 mm. may occur with the old pattern. We are not aware that such an error could be possible, especially as we know in Great Britain that the pressure depends merely on the difference in level in the two limbs of the U-tube, the capillarity effects being negligible. This head of pressure is independent of the shape and course of the intervening tube, and the exhortation by the makers to the physician "to admit his shortcomings on the mechanical side and review his elementary physics" might well be reciprocated. The desk-model submitted to us has a good appearance and is a well-finished instrument. The U-tube consists of a tubular left limb (bore $\simeq$ 0·5 cm.) and a much wider right limb (bore $\simeq$ 2 cm.). The change of zero is compensated for by graduating the left limb in 'calibrated millimetres.' The shift and disregard of the right limb reading also necessitates the bore of the left tube being taken into account, which we find has been done. The instrument possesses two definite advantages which will be appreciated by the busy clinician, namely (1) the wider left bore prevents air pockets and (2) the scale divisions ($\simeq$ 0·9 mm.) are easier to read and only the left limb has to be read. It must be pointed out, however, that the scale calibration stressed in this instrument has become necessary owing to the makers' deviation from the usual simple manometer with uniform bore and double reading. Further, the great increase in size of the bore of the tube involves a corresponding increase in the inertia of the moving mercury and consequent damping of oscillations.

MAGNETIC ALLOYS.—Mr. P. E. Billinghurst, writing from Camp Mizine, Salween River, Burma (c/o Messrs. Thomas Cook and Son, Rangoon), points out that if the atomic weight of each constituent of Heusler's alloy is multiplied by the fraction by weight of the element present and the sum taken, it is equal very nearly to the atomic weight of iron. He states that he has produced a number of similar magnetic alloys containing gold, bismuth, tin, silver, copper, and zinc, and found that the above relation holds for them equally well. Owing to the loss of his records by fire he is unable to give the actual figures.

LENGTHENED CHAIN COMPOUNDS OF SULPHUR.—We have received the advance proof of a paper on lengthened chain compounds of sulphur by P. C. Rây and K. C. Bose-Rây which is to be published in the *Journal of the Indian Chemical Society*, vol. 3, No. 2. According to V. Meyer, dithioethylene glycol reacts with ethylene bromide to give a mixture of 1 : 4 dithian and its polymer, the product varying according to the conditions. The polymer has been investigated by the authors and found to consist of a mixture of brominated long-chain compounds, including the substance $BrC_2H_4(S\ .\ C_2H_4)_{48}Br$, which is the first example of an organic sulphur compound with a molecular weight so high as 3068.

CADMIUM PHOTO-ELECTRIC CELL.—A cadmium photo-electric cell has been designed by Messrs. H. D. Griffiths and John S. Taylor to measure ultra-violet radiation of the range of wave-lengths which are of therapeutic importance. It consists of the cell itself, in which cadmium forms the active element, and a simple electroscope. The cadmium is deposited by distillation on a plate in front of which is a grid insulated from the plate. The radiation is admitted through a quartz plate and the cell is filled with hydrogen at a low pressure. In use, the grid is charged positively and thus attracts the electrons released from the illuminated plate. The instrument was found very sensitive to unscreened radiation from a quartz mercury lamp. By the use of various filters, it was found that visible and ultra-violet radiation of a wave-length longer than 3500 Å. had no appreciable effect on the instrument. There was no fatigue to be detected during a prolonged exposure. The instrument is sold by Messrs. Watson and Son, Ltd.

WAVE-LENGTH AND THE PHOTO-ELECTRIC BEHAVIOUR OF CRYSTALS.—In the *Zeitschrift für Physik* of July 12, Messrs. B. Gudden and R. Pohl direct attention to the apparent antagonism between the action of long and short wave-lengths when photo-electric absorption of light takes place in solid bodies. They show that it is not due to any real difference between the specific behaviour of the different waves. The essential effect of all wave-lengths is to split off electrons from the atoms, and the observed phenomena can be explained by assuming, in agreement with the experimental results, that a space element of the lattice is only able to support a definite maximum disturbance due to the photo-electric splitting off of electrons, the value of this maximum depending on the temperature. When the maximum is reached, a kind of breakdown takes place and the excited centres go back to their original unexcited state. The disturbances cause a widening of the spectrum on the long wave-length side, similar to that caused by thermal movements or lattice defects. The disturbances vanish as soon as the extra long wave-length light absorbed owing to the above widening has split off enough electrons to increase them above the critical limit.

RESISTANT STEELS.—A paper communicated to the recent Congress of Chemists in London by Messrs. T. G. Elliot and G. B. Willey, dealt with various types of steel now produced commercially by Messrs. Hadfields, Ltd., having great resistance to high and to low temperatures and to attack by chemical agents. The steels are of the austenitic type, and are characterised by high ductility, and by a tensile strength which is retained at high temperatures, one of them giving a value of 31 tons per sq. in. at 700° C. The creep test is even more important than the ordinary tensile test, as it indicates the stress at which a heated mass of the metal could stand for an indefinite time without change of form. The steel in question has a creep stress of so much as 11 tons per sq. in. at 700°. Alloy steels of this class also resist both scaling and warping when heated for long periods in air and subjected to rapid heating and cooling, so that they find a wide application as furnace fittings, hardening boxes, recuperator tubes, etc. Another variety, apparently differing somewhat in composition, is used for turbine blading. A third is used in low-temperature plant, retaining its ductility even in liquid air. For example, a Frémont shock test figure of 50 kg.m. has been obtained at − 195°, mild steel only giving 3 kg.m. The paper contains numerous figures relating to mechanical tests, and records of performance in use, including resistance to acids and other corrosive substances, a field in which so much progress has been made in recent years by the introduction of steels highly alloyed with nickel and chromium. The greater initial expense of such steels, and the greater difficulty of working them, are offset by the very greatly increased durability under the conditions to which the steels are exposed in chemical works and elsewhere.

The International Geological Congress at Madrid.

THE fourteenth session of the International Geological Congress was held in Madrid towards the end of May last. It was presided over by Señor D. César Rubio y Muñoz, under the honorary presidency of His Majesty King Alfonso. Señor Rubio is the President of the Board of Mines and was formerly President of the Geological Institute, entrusted with the preparation of the geological map of Spain. His successor, Señor D. Domingo de Orneta, who was to have taken an active part in the meeting, died shortly before it was held.

The Geological Congress is almost the sole survivor of the scientific congresses which formerly played such an important rôle in international scientific comity. It is still open to men of science of all nations, a distinction to which the scientific unions constituted under the International Research Council can lay no claim.

After a preliminary meeting of the Government delegates on the previous day, the congress was formally inaugurated by the King on Monday, May 24. The total number of members was more than a thousand. Many of these had already taken part in excursions to the Canary Islands and Morocco, or to Huelva, famous for its cupriferous pyrites, or other places of geological interest in the south of Spain. Toledo, Aranjuez, Almaden with its mines of mercury, and the Guadarrama mountains that separate Old from New Castile were visited during the meeting, and afterwards there were other excursions to the Balearic Islands, the potash deposits in Catalonia, the Pyrenees, the important coalfield of Asturias, and the iron ores in the neighbourhood of Bilbao.

The Spanish Government and the municipalities of Madrid and of the towns that were visited in the excursions extended splendid hospitality to the members of the Congress There was a Royal reception at the Palace, a gala theatrical performance, a municipal garden party, and a banquet at which the speeches, twenty-seven in number, commenced with the fish course. This was followed by a charming exhibition of national costumes, dances, and singing, in which the performers were all amateurs

In spite of these attractions, time was found in the different sections of the Congress for valuable discussions on matters of current geological interest.

There were a number of contributions on recent physical methods of studying the configuration and economic possibilities of the rocks of particular areas by electric, magnetic, and gravimetric methods, and observation of the propagation in the earth's crust of artificially produced vibrations.

The pyritic deposits of the south of Spain, to which reference has already been made, were the subject of important papers, and the greater part of two days was devoted to the discussion of the question as to whether they were formed by replacement or owed their origin to magmatic or pneumatolytic intrusion or deposition. Considerable attention was also given to the part played by Hercynian and Alpine movements in mountain building, more especially in Spain.

Perhaps, however, what was of the greatest interest to the British representatives was the consideration of questions of African geology in connexion with the proposed international geological map of Africa on a scale of one in five million, which was resolved on at the previous Congress at Brussels in 1922. A number of representatives of British African surveys were present as well as those of France, Belgium, Spain, Portugal, Italy, and Egypt. It was gratifying to note the progress that has been made in the interval. A geological map of the whole of South Africa has been recently published on a scale of one in one million, and one of Egypt on a scale of one in two million, and of South-West Africa on the same scale. Maps of the Anglo-Egyptian Sudan and Somaliland on a scale of one in three million, of the Gold Coast on one in one million five hundred thousand, and Gambia on one in five hundred thousand, and of all the remaining British African colonies or mandated territories, Nigeria, Uganda, Kenya, Tanganyika, Nyasaland, British Bechuanaland, and Northern Rhodesia, as well as of Southern Rhodesia, on a scale of one in two million, have been prepared, and work on other parts of Africa is well advanced. The map of the whole of Africa on the scale of one in five million will be prepared under the auspices of the Belgian Government as soon as all the materials are ready.

Of permanent value as a conspectus of the geology of Spain are the excellent guides, some nineteen in number, to the excursions. Many of them are published not only in Spanish but also in French, English, or German, or more than one of these languages. At the same time the Municipality of Madrid presented the members of the Congress with a well-illustrated volume on the Quaternary rocks of the Manzanares Valley by José Péres de Barradas.

The greatest achievement of the Congress, however, was the re-creation among geologists from all parts of the world of the atmosphere of friendliness and cordiality that prevailed in the days, which now seem so remote, 'before the War.'

Cancer Causation: Importance of Cell Physiology.

IN an interesting paper read before the German Chemical Society, at the meeting recently held at Kiel, Dr. Otto Warburg said that the attempts made artificially to produce carcinoma by tar-painting or by X-ray radiation showed that the normal tissues contain cells in which carcinoma may begin without help from any outside cells or micro-organisms. There is no cancer bacillus, just as there is no diabetes or arteriosclerosis bacillus The cancer problem is a problem of cell physiology in the narrow sense, and limited to the physiology of the body cells.

Since cancerous tissue grows differently from normal tissue, that is to say, irregularly and to excess, it follows that the metabolism of the cancer cell differs from that of the normal cell. Since, on the other hand, the carcinoma cell as an actual body cell originates from normal cells, it becomes necessary to correlate carcinoma metabolism with normal metabolism. Like normal organs, the tumour consumes oxygen and gives off carbon dioxide; the veins of the tumour contain less oxygen and more carbon dioxide than the arteries. Like normal organs the tumour requires glucose, and its veins contain less glucose than the arteries. But, unlike the normal organs, the tumour produces lactic acid which is passed into the blood, a portion of this acid being obtained from the blood sugar, which the tumour to a certain extent oxidises in the same way as normal organs, but for the most part splits into lactic acid. Careful research has shown that there is lactic fermentation of the glucose, and in fact there are a large number of different kinds of malignant tumours, for example, transplanted rat

carcinomata and sarcomata, the Peyton Rous chicken sarcoma, tar carcinoma in rabbits, and all kinds of human cancers, which qualitatively and almost quantitatively show the same result. We have here, therefore, a general characteristic of carcinoma and sarcoma cells which is entirely independent of any particular kind of irritation or of the nature of the normal tissue in which the tumours originate.

If, now, it be asked in what manner tumour metabolism arises out of normal cellular metabolism, it is necessary to inquire first of all under what conditions normal cells split glucose into lactic acid. Normal body cells produce lactic acid when their respiration is inhibited, either by cutting off the supply of oxygen or by poisoning. The production of lactic acid from glucose is, therefore, no peculiar property newly acquired when tumours first form, but is a property common to all body cells. But whilst in normal cells lactic fermentation is only set up by absence of oxygen, tumour cells always produce lactic acid, even when they are fully supplied with oxygen.

The results of these investigations may therefore be summed up in the statement that the tumour, so far as its metabolism is concerned, always behaves as a normal growing cell in a state of asphyxia. If normal growing cells be deprived of oxygen, then we have the reaction of a carcinoma cell. Since by deprivation of oxygen respiration is inhibited, fermentation cannot be masked or prevented, and the asphyxiated cells continue to produce lactic acid in excess, even when the oxygen supply is restored. Most of the cells so treated die because they are unable to live at the expense of energy of fermentation. Only a small number of them remain alive, and in their nature, magnitude and action they are indistinguishable from carcinoma cells.

Dr. Warburg then considered the question whether the asphyxia of normal growing cells sufficed to bring about the cancerous state, or whether other unknown factors also played a part. Reference was made in this connexion to the recent experiments of Carrel, Dresel and Wind, in which the attempt was made to discover whether carcinoma cells can not only exist without breathing, through energy of fermentation, but can also grow. The general conclusion was that tumour cells, like yeast, cannot live their full period without oxygen, but that both kinds of cells are able to grow for a time without oxygen, by the energy of fermentation, and that the asphyxiation of normal growing cells is sufficient to produce the cancerous state

Hæmoglobin.

HÆMOGLOBIN, the oxygen-carrier in the blood of vertebrates, upon which life depends, is a substance of great interest and importance, the investigation of which has received considerable attention from research workers. Prof. J. Barcroft, whose lecture on hæmoglobin, delivered before the Chemical Society on February 11, 1926, has been published in the Society's journal for May 1926, gives an account of recent investigations on the subject.

The old idea that hæmoglobin is a compound of two bodies, called *hæmatin* (containing iron) and a protein, *globin*, is not altogether untrue The well-defined crystalline substance *hæmin* is obtained by the action of glacial acetic acid on dried blood. When hæmin is oxidised in the presence of alkali, hæmatin is obtained. Alkaline reduction of hæmin yields *hæm*, a substance having an ill-defined spectrum. Nicotine, pyridine, globin, etc., when added to hæm, produce a class of substances with well-defined and similar spectra, called *hæmochromogens*. Of these it appears that the globin compound alone can form a hæmoglobin by regulation of the hydrogen-ion concentration. Cytochrome, another substance well known to the biochemist, has been proved by examination of the absorption spectrum to consist of three hæmochromogens.

The determination of the equilibrium constant K for hæmoglobin and oxygen and for hæmoglobin and carbon monoxide by the ordinary methods of gas analyses is exceedingly difficult on account of the low pressures of the gases involved, and methods have been worked out which involve spectroscopic measurements. The velocity constants, k and k', for these reactions have been obtained by an ingenious form of apparatus which overcomes the difficulties due to the high order of velocity by very rapid mixing of the components. For the reaction $HbO_2 \longrightarrow Hb + O_2$, k' is relatively small, whereas the constant for the formation of the oxide is very large and is also comparatively independent of the temperature and hydrogen-ion concentration. It follows that the equilibrium constant, $K = k'/k$, must be a measure of the effect of the reduction phase. Parallel observations with carbon monoxide show that the slow-reduction phase in the case of oxygen is peculiar.

There is a shift towards the blue in the position of the important α-band in the absorption spectrum when the hæmoglobin is treated with carbon monoxide. This shift, measured in Ångström units, is called the 'span,' and a nearly linear relation is obtained between log K and the span of hæmoglobins from various sources, where $K[HbO_2] \times [CO] = [HbCO][O_2]$. This is supposed to indicate that "there are a limited number of hæmoglobins, say two, which in different animals are mixed together in different proportions." The difficulties encountered in the measurement of osmotic pressures are also considered and in conclusion attempts are made to reconcile the equation, $Hb_4 + 4O_2 \rightleftharpoons Hb_4O_8$, which these measurements indicate, with the shape of the equilibrium curves previously obtained.

Contact Catalysis.[1]

THE Committee on Contact Catalysis under the chairmanship of W. D. Bancroft has performed an excellent piece of work in collecting together and commenting upon the interesting peculiarities of surfaces in affecting the rates of chemical change of reactants at, or in close proximity to, those surfaces. Whilst certain purists may object to the term 'contact' in connexion with reactions the velocities of which are accelerated by the presence of substances which, although taking part in the chemical change, are not present either in the reactants or products in stoichiometric quantities; yet the word possesses advantages in differentiating homogeneous reactions from reactions heterogeneously accelerated.

In the United States, Dr. H. S. Taylor himself has been largely instrumental in stimulating interest in problems in this field, which during the last decade has attracted an increasing number of research students in all countries, and from which a remarkable crop of new technical industries, not without economic value, has already been harvested.

In 1917 Langmuir showed that chemical reaction

[1] Fourth Report of the Committee on Contact Catalysis. By Hugh S. Taylor. *Jour. Phys Chem.*, xxx, 145, 171, Feb. 1926.

was probably restricted to the molecules of the reactants actually in contact with the surface. Whilst the experiments of Bone and others at high temperatures indicate that this generalisation may not be always true, yet in a large number of reactions such appears to be the case. Even in combustion at hot surfaces, reaction chains may start from, or, electrons or ions which in turn effect reaction may be emitted from the surface. Four years later it was shown simultaneously in England and the United States that the whole of a surface could not be equally uniform in affecting the rate of chemical action, certain portions of the surface being more active than others. Data both on the quantities and heats of adsorption of gases and vapours as well as the effect of poisons on the rate of catalytic action have amply confirmed the theory of active patches, as is shown in the present report.

It is clear that the existence of active patches is due to the fact that the surface of the catalyst is not uniform, but composite, consisting of various planes, corners and edges of minute crystals in addition to atoms isolated on planes and edges as well as atoms in the planes and edges. The work of Born and Lennard Jones on the surface energies of heteropolar compounds leads us to hope that the surface energies of the various portions of a composite metal surface may in time be computed. Only in the case of certain charcoals and of nickel do we possess any definite information on the extents and specific activities of various patches of different activities, but further information on this subject as well as the variation in relative areas will doubtless be forthcoming.

When we are in possession of data on the variation of the surface forces with chemical reaction rate taking place at the surface, some clue may be given to the mechanism of chemical activation, the elucidation of which is stimulating at the present time a renewed interest in the study of photochemistry.

It is to be hoped that such reports may be continued although the labour involved may render their appearance less frequent in future. Both the committee and Dr. Taylor are to be congratulated on this successor to the three reports already published.

ERIC K. RIDEAL.

University and Educational Intelligence.

CAMBRIDGE.—Mr. C. P. T. Winckworth, Christ's College, has been elected Eric Yarrow lecturer in Assyriology. Dr. C. L. Withycombe has been elected University lecturer in advanced and economic entomology. Prof. B. M. Jones has been nominated as a member of the Advisory Committee on Aeronautical Education. Dr. J. L. Witts, University of Manchester, and Mr. J. O. W. Bland, Jesus College, have been elected John Lucas Walker students in pathology. A grant of 100*l*. has been made from the Balfour Fund to Dr. H. Scott, Trinity College, towards the expenses of an expedition to Abyssinia. Mr. H. G. Cannon, Christ's College, and Miss S. M. Manton, Girton College, have been appointed to the University's table at the laboratory of the Marine Biological Association at Plymouth. An industrial bursary has been awarded by the Royal Commissioners for the Exhibition of 1851 to C. Salter, St. Catherine's College.

An interesting report has been published by the Appointments Committee giving a list of all the teaching appointments made under the new statutes and the grants made to the different faculties and departments from the Government grant. The total amount of new grants already thus allotted is 18,710*l*., out of 20,000*l*. available for the purpose.

The following have been elected to research studentships: W. J. Dann at Trinity College; B. C. Saunders at Pembroke College; W. A. Waters (chemistry), R. V. Thomas (chemistry), E. G. Jones (economics), J. G. Adshead (mathematics), H. Stayt (anthropology), T. E. Allibone (physics), and W. R. Wooldridge (biochemistry) at Gonville and Caius College; G. H. Aston, A. Caress, O. H. Wansbrough-Jones and B. J. Wood at Trinity Hall; J. Hilton at Christ's College; J. H. Ratcliffe at Sidney Sussex College; G. E. Watts has been elected Charles Kingsley bye-fellow at Magdalene College.

Further details are now available of the will of the late Dr. J. E. Bles, whose bequests to the University of Cambridge have already been referred to in these columns. He left all his scientific instruments, scientific books, and the fittings and contents of his private laboratory to the University of Cambridge, and he empowered his trustees to expend a sum, not exceeding 500*l*., in completing any researches made by him and publishing the results of any researches not published at the time of his decease. The value of his estate was 42,677*l*.; failing issue, and subject to his widow's life interest and after certain bequests, he left the residue of his property to the University upon trust for a professorship of animal embryology to be called the Charles Darwin professorship, for research and teaching in the subject from a purely scientific aspect; apart from economic, technical, or medical aspects, and subject thereto upon similar terms for a professorship of bio-physics. In the event of these chairs being already constituted, the legacy would have been devoted to the promotion of biological science and subject to a board consisting of the professors of biological subjects, which is also to examine the position of the fund every twenty-five years.

THE Calcutta University Poverty Problem lecturer, Captain Petavel, has for several years been carrying on a campaign of advocacy of a scheme for establishing near Calcutta a co-operative colony of middle-class 'home-crofters,' and in connexion therewith a school of which the pupils would "be systematically organised to produce their food by their own labour, the work being made instructive for them." In his magazine *Bread and Freedom* for July, he announces that a Mr. K. K. Dutta, a well-known Calcutta attorney, has placed at the disposal of his organising committee a village and farm, while another member of the committee has promised to contribute a sum of 10,000 rupees towards a fund for putting the scheme into operation "on business lines." A somewhat similar scheme was recently advocated by Prof. J. W. Scott, of University College, Cardiff.

FROM Loughborough College, Leicestershire, we have received a calendar for 1926-27, giving very fully detailed and illustrated descriptions of the College laboratories and courses in engineering and in pure and applied science including chemical technology. The College has also a Department of Administration and Economics, an Extra-Mural Department, a school of Industrial and Fine Art, and a secondary school for boys. The Faculty of Engineering is noteworthy for its system of concurrent theoretical and practical training, made possible by the large scale of the workshops, half the student's time being spent in productive work. The governors award annually five scholarships in the Faculty of Engineering, each of the value of 75*l*. per annum, open to British subjects in any part of the Empire. Candidates resident outside Great Britain can be examined at local centres.

Contemporary Birthdays.

August 20, 1860. Sir William Henry Ellis, G.B.E.
August 21, 1866. Sir Gerald P. Lenox-Conyngham, F.R.S.
August 21, 1858. Mr. Charles T. Heycock, F.R.S.
August 23, 1875. Prof. W. H. Eccles, F.R.S.
August 25, 1851. Sir John A. F. Aspinall.
August 25, 1844. Sir Thomas Muir, F.R S.
August 26, 1863. Mr. Edward Heawood.
August 26, 1873. Prof. William A. Osborne
August 26, 1860. Sir Thomas Ranken Lyle, F.R.S.

Sir WILLIAM ELLIS is president of the Institution of Civil Engineers, and a past president of the Iron and Steel Institute. He was master cutler of Sheffield from 1914 until 1917.

Sir GERALD LENOX-CONYNGHAM, reader in geodesy in the University of Cambridge, was educated at Edinburgh Academy, afterwards entering the Royal Engineers branch of the army. He was superintendent of the Trigonometrical Survey of India from 1912 until 1921. Sir Gerald is a member of the National Committee for Geodesy and Geophysics of the International Research Council

Mr. HEYCOCK, mathematician and metallurgist, is a fellow of, and lecturer in natural science in, King's College, Cambridge He was president of Section B (Chemistry) at the Cardiff meeting of the British Association in 1920. Mr. Heycock was awarded the Royal Society's Davy medal in that year on the ground of his researches in physical chemistry, more especially on the composition and constitution of alloys. While his work added to theoretical conceptions, it proved of importance also to industrial metallurgy.

Prof. ECCLES was born at Ulverston, Lancashire. He was the last dean and professor of applied physics in the City and Guilds of London Technical College, which was recently closed. Lately president of the Radio Society of Great Britain, he was, last month, elected president of the Institution of Electrical Engineers.

Sir JOHN ASPINALL was born at Liverpool. He was chief mechanical engineer of the Lancashire and Yorkshire Railway from 1886 until 1899. In 1919 he was appointed consulting mechanical engineer to the Ministry of Transport. Sir John is a past president of the Institution of Mechanical Engineers and of the Institution of Civil Engineers.

Sir THOMAS MUIR, for a long period—1892 until 1915—superintendent-general of education in Cape Colony, was born in Scotland. A graduate of the University of Glasgow, he was, early in his career, assistant professor of mathematics there. In 1883 the Royal Society of Edinburgh awarded him the Keith gold medal for his researches into the theory of determinants and allied questions. The unusual course was taken of allotting the medal again in 1897 for continued work in the same field, and once more in 1916 to mark the completion of the series down to 1915, all the memoirs having been published by the Society. Sir Thomas remains faithful to residence in Cape Colony.

Mr. EDWARD HEAWOOD is known to a wide circle as the accomplished librarian of the Royal Geographical Society, a post he has filled since 1901. Born at Newport, Shropshire, he was educated at Queen Elizabeth's Grammar School, Ipswich, graduating at Gonville and Caius College, Cambridge.

Sir THOMAS LYLE was born at Coleraine, Ireland. He graduated at the University of Dublin. From 1889 until 1915 Sir Thomas was professor of natural philosophy in the University of Melbourne.

Societies and Academies.

ROME.

Royal Academy of the Lincei, June 3.—Leonida **Tonelli**: The quadrature of surfaces.—A. **Bemporad**: The astrographic catalogue of Catania.—Ferruccio **Zambonini**: The presence in the products of the present-day activity of Vesuvius of a cæsiferous variety of potassium fluoborate. For a crystalline sublimate from Vesuvius, consisting of potassium and cæsium fluoborates in isomorphous mixture, the name 'avogadrite' is proposed.—Luisa **Pelosi**: Certain geometrical maxima and minima.—Mauro **Picone**: The singularity of harmonic functions.—Oscar **Zariski**: The impossibility of resolving parametrically by radicals an algebraic equation $f(xy)=0$ of the genus $p>6$ with general moduli.—Umberto **Crudeli**: Models of the helium atom.—R. **Mazet**: Oscillations of a liquid in connected vessels.—Vasco **Ronchi**: The limit of resolution of spectroscopic apparatus. The expression 'resolving power' of a prism, grating, etc., is shown to be inaccurate, since such apparatus is characterised only by dispersion. The resolution depends on the means by which it is examined and, when diffraction images are observed, is only one-half as great as when interference images are employed.—Mario **Picotti**: The results of the physico-chemical researches carried out on the Royal Italian cruiser *Marsigli* in the Straits of Messina. Observations on the temperature and salinity of the water are described.—Fausta **Bertolini**: Conformation of the stomach of the Teleostei in relation to the nutrition —M. **Sella**: The migration of the tunny studied by means of fish-hooks.

SYDNEY.

Royal Society of New South Wales, June 2.—M. S. **Benjamin**: A note on the rate of decomposition of commercial calcium cyanide. Decomposition was effected in a large closed glass container, and the percentage of hydrocyanic acid evolved was determined. The curves obtained indicate that carbon dioxide considerably accelerates the rate of change and factors other than the cyanogen content of the material affect the efficiency of a given dose of the material in practical fumigation.—G. **Harker** and R. K. **Newman**: Reactions depending upon the vapour at the interface of two immiscible liquids. The reaction between amyl acetate and acidulated water has been studied. The hydrolytic effect of liquid amyl acetate and of the mixed saturated vapour of amyl acetate and water at 100°, upon a surface of given area of dilute mineral acid, revealed a close agreement in the rate of hydrolysis. Taken in conjunction with the results previously obtained for benzyl chloride, it is therefore evident that at the interface of the two liquids the mixed saturated vapours of both liquids must be present. This is in agreement with the view of Van der Waals that there exists a continuous transition from the liquid to the vapour state at the boundary of any liquid.—A. R. **Penfold**: Notes on the essential oils from some cultivated Eucalypts. The specimens were grown from seed at Ashfield, near Sydney. The trees examined varied from three to eight years of age, and consisted of *E. Australiana*, *E. Macarthuri*, *E. citriodora* and *E. radiata* (*numerosa*). The *E. Australiana* was grown from seed collected at Wyndham, N.S.W., a place which yielded oils possessing a lævo-rotation of about -3.6 and containing phellandrene in small quantity, and as it would not meet the requirements of the various pharmacopœias the district had to be abandoned. The oils obtained from material grown

at Ashfield possessed an optical rotation of $+2\cdot5°$ to $3\cdot2°$ and were free from phellandrene. *E. Macarthuri* gave remarkable yields, varying from 0·5 to 0·74 per cent., as compared with 0·2 per cent. yield from the ordinary native material, whilst the geranyl acetate varied from 62 per cent. to 75 per cent., thus showing the influence of ecological conditions. *E. citriodora* yielded oils from 0·5 per cent. to 1 per cent., containing from 90 to 98 per cent. citronellal, and it would appear as if there were separate races existing within this species.—Miss P. **Nicol**: An investigation of the optical properties of selenium in the conducting form. Methods of preparing mirrors of selenium are described. The method gives values of γ_0 generally correct to within about 3 per cent. and of κ_0 to within 5 per cent. The values obtained vary within fairly wide limits, depending on the method of preparation (casting on glass, polishing, grinding, etc.). The results obtained are:

$\lambda =$ 6470-4170	$\nu_0 = 2\cdot7$ -$3\cdot36$	$\kappa_0 = 0\cdot45$-$0\cdot9$
$\lambda =$ 5890-5896	$\nu_0 = 2\cdot75$-$3\cdot06$	$\kappa_0 = 0\cdot77$-$1\cdot07$
$\lambda =$ 21900-8100	$\nu_0 = 2\cdot59$-$3\cdot02$	$\kappa_0 = 0\cdot90$-$1\cdot18$
$\lambda =$ 4400-4800	$\nu_0 = 2\cdot74$-$3\cdot04$	$\kappa_0 = 1\cdot05$-$1\cdot27$

Some rough measures in the near infra red indicated $\kappa_0 < 0\cdot1$ and ν_0 about 2·6. There was no definite indication of any relation between the temperature of transformation to the conducting form and the optical properties, nor was there any variation with the length of exposure to light or with the age of the specimen.

VIENNA.

Academy of Sciences, July 1.—F. **Hemmelmayr** and J. **Strehly**: Contributions to our knowledge of skoparin. Apparently this substance contains seven hydroxyl groups, and its formula is $C_{22}H_{22}O_{11}$ rather than $C_{20}H_{20}O_{10}$.—L. **Schmidt** and R. **Stöhr**: Two substances similar to stearine from *Asclepias syriaca*. A monovalent unsaturated alcohol $C_{31}H_{52}O$ and a divalent unsaturated alcohol $C_{45}H_{74}O_2$ have been obtained.—L. **Waldmann**: Petrographic description of the stones collected by L. Kober in the northern Hegas and in the Taurus.

Official Publications Received.

International Hydrographic Bureau Special Publication No. 12: Investigation of Harmonic Constants, Prediction of Tide and Current, and their Description by Means of these Constants By Rear-Admiral Phaff. Pp 80+6 plates. 5 Swiss francs. Supplement to Special Publication No. 12: Tables for the Calculation of Tides by Means of Harmonic Constants. Pp. 150. (Monaco.)

Straits Settlements Annual Report on the Raffles Museum and Library for the Year 1925. By C. Boden Kloss Pp. 14. (Singapore: Government Printing Office.)

Union of South Africa: Department of Agriculture. Reprint No. 4, 1925: Weeds of South Africa, Part 3 By K. A. Lansdell. Pp. 34+5 plates. (Pretoria. Government Printing and Stationery Office.) 3*d*.

The National University of Ireland Calendar for the Year 1926. Pp. viii+329+431+156. (Dublin.)

Department of Scientific and Industrial Research. Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1925; with Report of the Geological Survey Board and Report of the Director. Pp. vi+211+12 plates (London: H.M. Stationery Office; Southampton: Ordnance Survey Office.) 4*s*. 6*d*. net.

University of Bristol. The Annual Report of the Agricultural and Horticultural Research Station (The National Fruit and Cider Institute), Long Ashton, Bristol, 1925 Pp. 152+11 plates. (Bristol.)

Report of the Imperial Institute of Veterinary Research, Muktesar, for the Year ending 31st March 1925. Pp. ii+59. (Calcutta: Government of India Central Publication Branch.) 1.14 rupees; 3*s* 3*d*.

Records of the Geological Survey of India Vol. 59, Part 1: General Report for 1925, by Dr E. H. Pascoe, The Zonal Distribution and Description of the larger Foraminifera of the Middle and Lower Kirthar Series (Middle Eocene) and parts of Western India, by W. L. F. Nuttall. Pp. 164+8 plates. (Calcutta: Government of India Central Publication Branch.) 2.12 rupees; 5*s*.

Ceylon Journal of Science. Section A: Botany. Annals of the Royal Botanic Gardens, Peradeniya. Edited by A. H. G. Alston. Vol. 10, Part 1, June 15th. Pp. 144+2 plates. (Peradeniya: Director of Agriculture; London: Dulau and Co., Ltd.) 3 rupees.

The Scientific Proceedings of the Royal Dublin Society. Vol. 18 (N.S.), No. 22: The Downy Mildew of Onions (Perenospora Schleideni), with particular reference to the Hibernation of the Parasite. By Dr. Paul A. Murphy and Robert M'Kay. Pp. 237-261+plates 12-15. 4*s*. Vol. 18 (N.S.), No. 23: A simple Method of Temperature Control for use with Refractometers and Polarimeters. By Michael T. Casey. Pp. 263-264. 6*d*. Vol. 18 (N.S.), No. 24: The Dehydration Rates of Conifer Leaves in relation to Pentosan Content. By Joseph Doyle and Phyllis Clinch. Pp. 265-275. 1*s*. (Dublin.)

Forestry Commission. Sixth Annual Report of the Forestry Commissioners, Year ending September 30th, 1925. Pp. 32. (London: H.M. Stationery Office.) 9*d*. net.

Jamaica Annual Report of the Department of Agriculture for the Year ended 31st December 1925. Pp. 23. (Jamaica, B.W.I.)

Diary of Societies.

SATURDAY, AUGUST 21.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Annual Meeting) (at Newcastle-upon-Tyne), at 2.30.

CONGRESSES.

AUGUST 27 AND 28.

IRON AND STEEL INSTITUTE (Autumn Meeting) (at Stockholm).—F. Adcock: The Effect of Nitrogen on Chromium and some Iron Chromium Alloys (Alloys of Iron Research, Part IV.). J. H. Andrew and H. A. Dickie: A Physical Investigation into the Cause of Temper Brittleness.—Prof. C Benedicks, H. Backstrom, and P. Sederholm: Anomalies in Heat Conduction, with some Determinations of Thermal Conductivity in Iron and Carbon Steels.—Prof. C. Benedicks and R. Sundborg: Electrochemical Potentials of Carbon and Chromium Steels.—G F. Comstock: The Treatment of Steel with Ferro Carbon-Titanium.—G. A. Hankins, D. Hanson, and Miss G. W. Ford: The Mechanical Properties of Four Heat-Treated Spring Steels.—Prof. K. Honda: Is the Direct Change from Austenite to Troostite Possible?—A Johansson and R. Von Seth: The Carburisation and Decarburisation of Iron and Some Investigations on the Surface Decarburisation of Steel.—A. Johansson and A. Wahlberg: The Development of the Swedish Iron and Steel Industry during the last thirty years.—E. Kinander. Notes on Jernkontoret.—A. Lundgren: The Testing of Hardened Steel.—W. Petersson: Notes on the Development of the Swedish Mining Industry during the last twenty-five years.—G. Phragmen. The Constitution of the Iron-Silicon Alloys.

AUGUST 29 TO SEPTEMBER 1.

SOCIÉTÉ HELVÉTIQUE DES SCIENCES NATURELLES (at Fribourg).—In Sections devoted to Mathematics, Physics, Geophysics, Meteorology and Astronomy, Chemistry, Geology, Mineralogy and Petrography, General Botany, Special Botany and Geographical Botany, Zoology, Entomology, Anthropology and Ethnology, Palæontology, Medical Biology, History of Medicine and Natural Science.

AUGUST 31 TO SEPTEMBER 8.

WORLD POWER CONFERENCE (at Basle), Technical Programme of Sectional Meeting:
Utilisation of Water Power, and Inland Navigation.
Exchange of Electrical Energy between Countries.
The Economic Relation between Electrical Energy Produced Hydraulically and Electrical Energy Produced Thermally: Conditions under which the two systems can work together with advantage.
Electricity in Agriculture.
Railway Electrification.

SEPTEMBER 1 TO 4.

INSTITUTE OF METALS (Autumn Meeting) (at Liége) (September 1, at 8—Dr. W. Rosenhain: Ancient Industries and Modern Metallurgy) (Autumn Lecture) Dr. C. J. Smithells, H. P. Rooksby, and W. R. Pitkin: The Deformation of Tungsten Crystals.—Prof. K. Honda: A Comparison of Static and Dynamic Tensile and Notched-Bar Tests.—C. H. M. Jenkins: The Constitution and the Physical Properties of the Alloys of Cadmium and Zinc.—H. J. Gough, S. J. Wright, and Dr. D. Hanson: Some Further Experiments on the Behaviour of Single Crystals of Aluminium under Reversed Torsional Stresses.—B. Ōtani: Silumin and its Structure.—G B. Phillips. The Primitive Copper Industry of America. Part II.—Kathleen E. Bingham: The Constitution and Age-Hardening of Some Ternary and Quaternary Alloys of Aluminium containing Nickel.—Dr. A. G. C. Gwyer and H. W. L. Phillips: The Constitution and Structure of the Commercial Aluminium-Silicon Alloys. With an Appendix upon The Properties of the Modified Aluminium-Silicon Alloys, by Dr. D. Stockdale and I. Wilkinson.—J. D. Grogan: Some Mechanical Properties of Silicon-Aluminium Alloys.—Dr. C S. Smith and Prof. C. R. Hayward: The Action of Hydrogen on Hot Solid Copper.—Capt. F. R. Barton: The Development of the Use of Nickel in Coinage.—A. Pinkerton and W. H. Tait: Season-Cracking in Arsenical Copper Tubes.—Prof. P. Chevenard: Thermal Anomalies of Certain Solid Solutions.—W. T. Cook and W. R. D. Jones. Preliminary Experiments on the Copper-Magnesium Alloys.—F. W. Rowe: Bronze Worm Gear Blanks produced by Centrifugal Casting.—L. Boscheron: An Account of the Non-Ferrous Metals Industry in the Liege District.

SEPTEMBER 6 TO 11.

AMERICAN CHEMICAL SOCIETY (at Philadelphia).—In eighteen Divisional Gatherings, dealing with various branches of Pure and Applied Chemistry.

SEPTEMBER 13 TO 17.

INTERNATIONAL CONGRESS OF PHILOSOPHY (at Harvard University, Cambridge, Mass.).

SATURDAY, AUGUST 28, 1926.

CONTENTS.

African Natives and European Civilisation.

IN his presidential address to the British Association, H.R.H. the Prince of Wales spoke with singular felicity of the relations which do actually, and should, subsist between the State and scientific research. The discussion of a multiplicity of topics, which was released as it were from a floodgate immediately after the inaugural meeting, may have obscured the fact that the opportuneness of the Prince's reference to the application of scientific study to the problems of the Empire in our Dominions and Dependencies was conclusively demonstrated by the presidential address delivered in the Geographical Section on the following day. The lesson was further driven home by the discussion on the effect on the native races of Africa of contact with European civilisation which arose directly out of Mr. Ormsby-Gore's address, and took place in a joint session of the Sections of Geography and Anthropology.

His Royal Highness spoke as one who had had many opportunities in peace and in war to observe the facts, the necessities, and the possibilities of conditions in the Empire as a whole. In like manner, if in a more restricted field, Mr. Ormsby-Gore laid before his hearers the results of his journeys of observation in East and West Africa—journeys which may become as memorable and as far-reaching in effect as those of Joseph Chamberlain when the latter was Minister of State for the Colonies. Those who have followed the newspaper reports of Mr. Ormsby-Gore's travels with some knowledge of the problems which were then brought before him, will appreciate the acute observation and the balanced judgment which underlie his summary of the situation in regard to the economic development of tropical Africa and its effect on the native population. It is, however, of no little significance that his lucid summary of the needs of Africa and its people is followed by an acknowledgment of the greatness of our opportunities and our responsibilities and an appeal for the continued efforts not only of "officials and unofficials in Africa," but also of "the men of science over a whole range of human experience such as are meeting under the auspices of the British Association." It is pardonable if in these words we think we hear the statesman and the administrator rather than the president of Section E.

It cannot be denied that the need of constructive thinking for which Mr. Ormsby-Gore pleaded is urgent. The situation in Africa was summed up by one speaker in the discussion as one of depopulation and disintegration, and he went on to point out that the African native has passed in a brief space of time from the Stone Age to the present day. The final partition of Africa among

the European powers began in the last decade of the last century. Since then the economic development of the country has proceeded at a rapid pace, but especially in the last few years. Figures are quoted in Mr. Ormsby-Gore's address which are worth repeating. Between 1921 and 1925 the domestic exports of Nigeria increased from 8,250,000*l.* to 17,000,000*l.*; in the Gold Coast in the same period from 6,000,000*l.* to 10,000,000*l.* In East Africa the increase is even more marked, due almost entirely to the development of cotton-growing. In Kenya and Uganda the figures for the corresponding years show an increase from 2,250,000*l.* to 7,820,000*l.*, and in Tanganyika Territory from 1,100,000*l.* to 2,900,000*l.* This sudden accession of wealth would not be without its element of danger in any community; but when it is realised that the greater part represents the earnings either as producers or as wage-labourers of a population to whom 'money' is still novel, and whose ideas of a currency and medium of exchange not so long ago were limited mainly to 'brass rods' or 'cloth,' it must be apparent that the problem is both immediate and grave. It is a problem which demands statesmanship, and a statesmanship which is informed with an intimate knowledge of the African, of his institutions, and of his needs.

It is not possible to set back the clock. For good or for ill, the economic development of Africa is bound to go on under pressure of an increasing world-demand for its raw materials and its market for imports. Apart from certain restricted areas which will be exploited for their mineral wealth, it will be developed as an agricultural country. In tropical Africa, where white labour is impossible, that development will depend upon the native. Even in South Africa it is doubtful if white labour will ever be able to hold its own. Whatever may be the ultimate result in South Africa, in the tropics it seems clear, owing to climatic conditions and the question of prestige, that the function of the white man is to act as an administrator or employer and the guide and teacher of the native.

Up to the present it cannot be said that this rapid development of Africa has been for the good of the native on the whole, even though it be recognised that certain benefits have accrued to him. It is doubtful, indeed, how far these benefits may be for his ultimate good unless steps are taken to neutralise the inevitable disabilities by which they are accompanied. It has also to be admitted, as has been pointed out recently by a resident of many years in the remoter parts of East Africa, that the native does not always accept the advent of the white man who comes to exploit his land as an unmixed blessing. The African has a distinctive culture of his own, in which the cardinal features are the religious beliefs which are interwoven as an essential element in every aspect of his life, and the communal spirit which informs his thoughts and actions as a member of a tribal group. Notwithstanding differences as between tribes and peoples in the form of their political organisation, this is true of all in general terms. Especially is it essential to remember that the ultimate sanction of chiefly and tribal authority is religious. Further, apart from provision for the needs of the family and any contribution due to the chief or the community, the idea of the economic value of labour applied to production from the land or of wage-earning is alien to the native mind. Until recently, and as is still the case in many tribes, wealth consisted exclusively of wives and cattle. One of the reasons for the imposition of a hut-tax on the native population in South Africa was the hope that incidentally it would familiarise the native with the advantages of wage-earning and thus increase the supply of labour.

It is self-evident that the sudden impinging of European civilisation on a culture of this type, and the rapid economic development of the country, are bound to result in an equally rapid disintegration of native institutions. The growth of a class of native producers and of wage-earners has rendered the individual conscious of his individuality as a unit rather than merely as a member of a social organism, while introduction to the tenets of Christianity, an individualistic body of belief, has still further strengthened this tendency. The authority of the chief and the sense of responsibility to the tribe have been undermined, and the religious bond upon which they depend has been loosed. In the coast towns of West Africa, natives have become completely detribalised, and if the process is allowed to go on unchecked the existing tribes are in danger of becoming undisciplined mobs. Again, the native system of land-tenure, about which, incidentally, insufficient is known, is in danger. The economic value of land is beginning to be appreciated by the native, and where land is vested in the chief, this has introduced an entirely new relation of landlord and tenant as between the chief and the individual member of the tribe. Of the importance of a knowledge of the system of land-tenure, the disastrous experience of South Africa up to the passing of the Glen-Gray Act is a sufficient indication. Here, too, notwithstanding the reservation system, detribalisation, except in the case of the Zulu, is proceeding rapidly.

Of the results of this tendency to detribalisation, little need be said. They are obvious. The lack of restraint, and the accompanying break-up of the *morale* of the native, unless checked, are bound in the long run to be disastrous. They must accelerate the depopulation of the country, which, owing to disease and especially infant mortality, is already a serious factor in the

situation. Improved sanitation, a higher standard of nutrition, and increased efficiency in medical service may, however, be expected to cope with disease as time goes on; but an informed and intelligent guidance based upon a sympathetic understanding of native psychology, which will control and direct into safe channels the inevitable modification of the full tribal system, is an essential condition of the well-being of the native, and in the long run of the prosperity of Africa.

The present tendency to unchecked detribalisation is the more to be regretted in that the African native is one of the most adaptable of all the primitive races in the world, when the innate conservatism based on his religious taboos is not affected. This is shown by the readiness with which the native has mastered new arts of life in the course of the opening up of his country. Many of the African natives have beside, as the study of their history and institutions shows, a remarkable instinct for social and political organisation. The genius of Chaka, the great chieftain of the Zulu, is by no means unique in the annals of African tribes. This capacity for organisation and government is not confined to the men but has been displayed on more than one occasion by women, who by some accident or other have attained positions of authority.

A hopeful feature of the situation is the intense desire of the African for education. Hitherto the only form of education available for the native, with the exception of the interesting experiment at Achimotu, has been upon European lines; but education in Africa must take a new orientation. It is clearly of little use to offer the African a system of education which was designed originally to meet the needs of a European environment. Too often it has been the case that the curriculum of native schools has been framed with an eye only to the literary side of education, to the neglect of practical subjects. Yet it is not enough to insist on the need for vocational training. Even while recognising the excellence of much of the work which has been done in this direction, too great emphasis cannot be laid upon the fact that the education of the native must be based upon an intensive study of the culture, the institutions, and the needs of the African population. Much, it is hoped, may yet be effected through the Committee on Education of the Colonial Office. For many years the anthropologists have been collecting the facts, and although they are well aware that these facts may still be incomplete in certain respects, yet in response to Mr. Ormsby-Gore's appeal for the assistance of scientific workers they are ready and willing to place their knowledge at the disposal of the administrator for its practical application in the training and government of the native community of the new Africa.

An Indian Clan in Wales.

The Dialect of the Gypsies of Wales: being the Older Form of British Romani preserved in the Speech of the Clan of Abram Wood. By Dr. John Sampson. Pp. xxiii+230+419. (Oxford: Clarendon Press; London: Oxford University Press, 1926.) 84s. net.

THE majority of people are surprised when they are told that in almost every country of Europe, and even in America, there is spoken to-day a language which was brought out of India by a tribe or tribes between twelve and fifteen hundred years ago. This is the language of the people known to us as Gypsies, to themselves as Rom or the like, a word which phonologically is the exact equivalent of the modern Indian Ḍom, a general name for an outcast, so-called criminal tribe, who in many places act as scavengers and burners of corpses, and in all places are ready to augment their earnings by stealing or other anti-social practices. The Gypsies of Palestine and Syria still call themselves Dom, just as with them a spoon, *roi* in European gypsy, is *dowi* (and in modern Hindi *ḍoī*).

It has long been recognised that the speech of the Gypsies, which, as regards the European branch at least, differs comparatively little from country to country, is like the modern Indo-Aryan vernaculars of India—Kashmiri, Panjabi, Sindhi, Gujarati, Marathi, Hindi, Bengali, and the rest—descended from an old language of which we have the literary form in the language of the Rigveda and in Sanskrit. Consideration of its sound-changes and of its vocabulary makes it certain that the Gypsy language, or Romani, originally belonged to the same dialect-group as gave birth to the present central languages of India, such as Hindi. At a comparatively early period, however, which must be dated before the beginning of this era, they had wandered away to live for a time with the ancestors of the wild and little-known tribes of the north-west frontier, among the mountains of the Hindu Kush. Linguistically these tribes are very conservative in certain respects; and, being with them, the Gypsies preserved certain sounds and groups of sounds which were afterwards lost by those they had left behind in India proper. Whereas, for example, in India an original *t* or *d* coming between vowels was altogether lost, it is preserved in some form or other only by two of these north-western dialects and by Gypsy. European Gypsy keeps them under the form of *l*, Syrian Gypsy under the form of *r*. It is then of peculiar interest to note that, of the two north-western dialects which also preserve them, Khowar, spoken in Chitral, has *r*, and Kalasha, spoken farther south, has *l*. Thus the word which in Pali (a later form of Sanskrit) is *deti*, 'he gives,' is Hindi *de*, but Khowar

dōr, Kalasha *dali*, Syrian Gypsy *der*, European Gypsy *del*.

About A.D. 400 this region was disturbed by the Hun invasions of India. By them perhaps the Gypsies were set in motion towards the west. At all events, before A.D. 900 we find them in Persia, where various legends are related to account for their presence. A succinct account of their wanderings from here has been given by Dr. Sampson in a recent number of the *Journal of the Gypsy Lore Society*. Their path can be traced by the words which they picked up and adopted from the languages of the countries through which they passed. From Persia the Gypsies who changed original *-t-* to *r* migrated into Syria, from where some went north into Transcaucasia, others south into Egypt. Those, on the other hand, who changed *-t-* to *l* passed on into Armenia, where some remain until the present day; others, driven forward by the Turk inroads, migrated through Asia Minor into the Balkan Peninsula before the end of the eleventh century; and here it is that we first have definite historical record of this strange people. In Greece they stayed for a long period, to which also the numerous Greek loan-words in their language bear witness. But early in the fifteenth century—again before the threat of the Turkish invasion—they once more began their wandering. Their bands moved rapidly, and in a very short while they had appeared in almost every European country.

Wherever they went they were persecuted, and statutes were passed for their suppression and expulsion. It is therefore easily to be understood that it was greatly to their advantage to have a language which was not intelligible to their enemies. This doubtless was a powerful factor in the preserving of their old Indian tongue, despite the comparative smallness of their numbers and their wide separation both from the land of their origin and among themselves. Of recent times, however, and particularly in England, where they have never been very numerous, their speech has degenerated into a jargon, which is little more than a certain number of Gypsy words set in an English framework, with English grammar and English syntax. We may note, in passing, that the borrowing has not been entirely one-sided, and the number of slang words and phrases taken from Gypsy is probably considerable. One at least has acquired universal use: for the word 'pal' is English Gypsy *phal* (in which *ph* is an aspirated *p*, not *f*), meaning 'brother,' Continental Gypsy *phral*, and direct descendant of Sanskrit *bhrātā*.

Those readers (and fortunately they are many) whom the works of Borrow have acquainted with the Gypsies and their language, though already in a much degenerated form, will be astonished when they study the monumental work now before us on the language spoken by a Gypsy clan in Wales to-day. This is still really an Indian language, not a mere jargon. Students, not only of language and of the Indian languages in particular, but also of culture and folklore, owe a great debt to Dr. Sampson, both for his original discovery of Edward Wood, the Welsh Gypsy harper, at Bala in 1894, and for the enthusiasm and perseverance which has carried him through thirty-two years of patient collecting and sifting and arranging of stories and other linguistic material from this little Indian clan among the mountains of Wales, work which has at last resulted in a volume of more than 650 pages. It is by far the most complete and most accurate description of any Gypsy dialect that we possess. The first 230 pages are devoted to a description of the sounds, forms, and syntax of the language; the next 419 to a vocabulary, full of quotations, and precisely indicating the meaning and use of each word. If there is one part more than another to which we would refer as especially valuable, it is the pages which contain a minute and scientific description of the sounds of the language. We regret that it was impossible to include a certain number of texts, but presumably the already great size of the volume forbade a further addition. But those who are interested will find a large number of stories published by Dr. Sampson, with notes and translations, in the *Journal of the Gypsy Lore Society*.

In one respect only do we criticise Dr. Sampson's work adversely. Comparative philology, though almost the first impulse to its scientific study was given by that great English scholar and orientalist, Sir William Jones, has never been a plant of vigorous growth in England; and the languages of India, which Englishmen have had peculiar opportunity of acquiring, have suffered more at the hands of amateur philologists perhaps than any other group of languages. The scientific study of the history of the modern Indian languages is a comparatively recent growth, and the workers are still far too few. Gypsy, like the other Indian languages, has also suffered at the hands of amateurs. Some of its students have been famous linguists; but the greatest of them all, Miklosich, wrote before the fruitful ideas of the "Junggrammatiker" saw the light and changed the whole basis of the science of comparative philology. Dr. Sampson unfortunately yielded to the temptation to combine history with description; and throughout the book he attempts to trace the history of Gypsy from Sanskrit onwards. But though the science of language has made such enormous strides during the last fifty years, Dr. Sampson does not seem to have progressed beyond

the days of Miklosich. Examples of this are to be found in profusion on almost every page. We will take two only, to serve as illustrations of our criticism.

Without a recognition of the principle of the constancy of so-called sound-laws, there can be no science of etymology. This principle is that a given sound in a given dialect will develop in the same way in all words in which it appears under the same conditions. Thus Sanskrit words containing intervocalic *-t-*, if they survive, will in Hindi lose the *-t-* altogether, in European Gypsy show it as *l*. An etymology which neglects this rule is at once suspect; and if it is to be upheld, some special reason must be sought, such as borrowing from another dialect or the like. But Dr. Sampson has no compunction in making etymologies which go contrary to well-established rules of Gypsy, and that without noting the fact or seeking for explanation. Thus it is a sound-law of Gypsy (and of nearly every other modern Indo-Aryan language) that original intervocalic *-k-* is lost: this is admitted by Dr. Sampson, who gives for example the Sanskrit ending *-ako*, which became Middle Indian *-ao* and Gypsy *-o*, or the Sanskrit *yūkā*, 'louse,' which became Gypsy *juv*. Yet without hesitation he derives Gypsy *šukār*, 'quiet,' from Sanskrit *sukṛta-*, 'well done' (which in Gypsy would have become something like **suil*). It is, on the contrary, doubtless from Sanskrit *śukrá-*, 'bright, pure, clear.'

Secondly, Dr. Sampson compares Gypsy words not only with what he considers the Sanskrit originals, but also with their Hindi congeners. Now, just as French contains not only inherited Latin words (like *père*, derived from *patrem*), but also borrowed Latin words (like *paternité*, borrowed from *paternitas*), so too Hindi has both inherited Sanskrit words and borrowed Sanskrit words. If we wish to investigate the history of Latin sounds, say in Italian and French, we must compare the inherited Latin words in one language with the inherited Latin words in the other language, not an inherited word in one with a borrowed word in the other: we must compare Italian *padre* with French *père*, not with *paternité*. But Dr. Sampson, in countless cases, compares an inherited Gypsy word with a borrowed Hindi word: for example, he compares Gypsy *thulo*, 'fat' (connected with Sanskrit *sthūlá-*, 'strong'), not with, say, the inherited Nepali word *ṭhulo*, id., but with the borrowed (and only very literary) Hindi word *sthūl*.

Such an attitude and such mistakes invalidate the whole of Dr. Sampson's comparative work: it cannot be accepted as in any way a trustworthy guide. It is indeed a pity that this fine book, which is otherwise such a splendid monument to the author's scholarship, should be so marred. How far better would it have been if either he had followed his first intention (as expressed in the preface) and left the historical side alone, or by a much profounder study of comparative philology in general and Indo-Aryan philology in particular have fitted himself for the task of comparison with other Indo-Aryan languages. But since perfection is not attainable by man, we may be grateful that Dr. Sampson has given us a work which not many could have accomplished.

R. L. TURNER.

Ice Ages.

Ice Ages: Recent and Ancient. By Prof. A. P. Coleman. Pp. xliii + 296. (London: Macmillan and Co., Ltd., 1926.) 17s. net.

EARLY glaciologists wrote of 'The Ice Age,' next of 'The Great Ice Age,' and when it became obvious that there had been earlier refrigerations not inferior in intensity to the latest, of 'The Quaternary Ice Age'; now we have a glacial history of the earth, and from the hand of a master of the subject. Many of the glacial deposits described have only been discovered within the past few years; it is probable that many more will be found in the future, but Prof. Coleman presents enough material to enable us to form an idea of the distribution of glaciation both in space and time.

Deposits referable to ice are now known or suspected from nearly all the main geological formations, but many of them are of small extent and can be attributed to valley or at most piedmont glaciers. Major glaciations are known from the Lower Proterozoic or Huronian, the Upper Proterozoic to Lower Cambrian, the 'Permo-Carboniferous' and the Pleistocene. Minor glaciations are known or suspected at other levels in the pre-Cambrian (though owing to the difficulties of correlation it is not possible to say how many), in the Ordovician (North America and doubtfully in Europe), and in the Silurian-Devonian (Alaska, eastern Canada, Cape Town). The great 'Permo-Carboniferous' glaciation was manifested in five continents at least, but mainly in the southern hemisphere and in India; in strong contrast was the generally warm Mesozoic, from which only two glacial deposits are described, a tillite from central Africa west of Lake Tanganyika, probably Triassic but possibly older, and a Jurassic moraine from California, both probably formed by piedmont glaciers.

During the whole of the Mesozoic the sea-level temperature remained high, and the great cold-blooded reptiles were able to multiply and dominate the earth. Coleman attributes their sudden disappearance to a "slight dip in temperature at the end of the Cretaceous, too small to be called an ice-age." This slight cooling is indicated by the valley moraines of Cape Hamilton

in the Antarctic and the Cordilleran region of North America; the ice-transported boulders of the Cretaceous of South Australia and England are not mentioned, presumably because they are attributed to shore ice and not to land ice. There may have been mountain glaciers in the Miocene of Iceland and Europe, but these were local, and the next great cooling occurred at the close of the Pliocene and still continues.

These phenomena offer a definite meteorological problem, which the author sets out clearly in words which are worth quoting:

"Under normal conditions the world has a relatively mild and equable climate with no permanent ice at low levels even in the polar regions."

"From time to time . . . there have been relatively short periods of cold accompanied by a great extension of mountain glaciers, and sometimes also by the formation of ice-sheets at low levels. In the most severe visitation of the kind ice-sheets invaded the tropics on three or perhaps four continents."

"Ice ages are, in most cases, broken by interglacial periods of milder climate. Sometimes this occurs two or three or more times, indicating a comparatively rapid oscillation from cold to warm and warm to cold."

"All parts of the world have their temperature lowered during an ice age, the tropics as well as the temperate and arctic zones."

The author then turns to the consideration of causes, but gives only a rather mechanical discussion of the various theories of climatic change which have been put forward from time to time. Wegener's theory of continental drift is mentioned, but without enthusiasm. Elevation perhaps comes nearest to a solution, but fails to account for world-wide cooling. The conclusion is that no single cause suffices; "some combination of astronomic, geologic, and atmospheric conditions seems to be necessary to produce such catastrophic events in the world's history."

The difficulty of the problem is increased by the apparently haphazard way in which glaciations have developed. Time and again the author comments on the paradox of field-work, especially on Permo-Carboniferous tillites, beneath an almost vertical sun in a temperature suggestive of anything but ice. On the other hand, so far as is known at present, the Antarctic continent escaped glaciation until the close of the Mesozoic, though of course the great Antarctic ice-sheet may hide traces of many older glaciers. The north-east of North America, where the Quaternary ice-sheets reached lower latitudes than anywhere else, has suffered glaciation over and over again. In the Upper Carboniferous this region bore glaciers which indeed pale into insignificance beside the contemporaneous ice-sheets of the south, but would be sufficiently remarkable in any other period. The same region was ice-covered in the Devonian, the Ordovician, at the close of the Proterozoic, in the Lower Huronian (a photograph shows the remarkable feature of a Huronian tillite smoothed and striated by a Pleistocene ice-sheet), and perhaps at two horizons in the Archæan —seven or eight glaciations in the same or neighbouring areas. Other regions which have suffered repeated glaciation are Alaska, South Africa, and south-east Australia, though South Africa was not glaciated during the Pleistocene.

It almost seems as if, given certain conditions, and especially a world-wide cooling, glaciers and even ice-sheets can develop in any latitude, but have a preference for certain localities. From this point of view it may be only an accident that the two great ice-sheets of the present day occur in high latitudes. Their formation is not entirely a matter of temperature, since we are faced by the idea that during most of geological time the polar regions were free of land ice even while lower latitudes were being glaciated. Apart from pole-wandering, the only theory which throws any light on this anomaly is Paschinger's, not mentioned by Coleman, that glaciation depends on the relation between the zone of maximum snowfall and the snow-line. It may be profitable to try to fit this theory to the facts before us.

As we go from the lowlands up the slopes of a mountain range, we find that the snowfall increases up to a certain level, above which it again decreases; this level depends mainly on the humidity and the temperature during the wettest season. Quite distinct, depending mainly on the summer temperature, is the snow-line. If the snow-line is above the zone of maximum snowfall, the glaciers will be small; if the snow-line is the lower, the glaciers will be large, and with sufficient snowfall may descend to low levels. In the moist equatorial regions the two zones are close together, and a small depression of the snow-line would produce a considerable extension of the glaciers.

It seems probable that glaciers or ice-sheets must always *originate* on high ground, but for a glacier to develop into an ice-sheet a large area of more or less level ground is required at a temperature low enough for the ice to spread out as a piedmont glacier. In high latitudes this land may be low, but in low latitudes it must be initially at a high level. Once the ice-sheet has reached a certain size, however, it imports its own climate, and the initially high plateau may be depressed nearly to sea-level without necessarily destroying the ice-sheet. There are several reasons for this; one of the most important is that a snow surface reflects four-fifths of the solar radiation falling on it, and another is that a large ice-sheet is naturally occupied by an anticyclone with outwardly directed winds. The relations between snow-line and zone of maximum

snowfall probably depend on conditions of storminess and vertical temperature gradient which are due to general causes; when these are favourable, glaciers will form which may develop into ice-sheets in suitable localities, determined partly by configuration, which is independent of latitude, and partly by location relative to storm tracks and oceans. The latter proviso causes the repetition of glaciation in certain localities which are not necessarily the coldest parts of the globe. During the course of an ice-age the most suitable location may change, which brings us back to Coleman's speculation that the Greenland ice-sheet may represent the continuation of the eastward trend of glaciation in America, having commenced later than the American ice-sheets and persisting after them.

The author has done good service by uniting in one volume a large mass of material which was formerly only available in scattered papers or, in the case of his own observations, had not previously been published. The volume maintains the high standard which we expect of the publishers; it is lavishly illustrated by photographs of great interest, and the only error which the reviewer has noticed is the name "Grygalski" on page 286.

C. E. P. BROOKS.

The Sylvester Programme in Algebra.

Matrices and Determinoids. By Prof. W. E. Cullis. (University of Calcutta: Readership Lectures.) Vol. 3, Part 1. Pp. xix + 681. (Cambridge: At the University Press, 1925.) 63s. net.

WE are all familiar with Cartesian co-ordinates denoted by $[x, y]$, where two numbers written in an assigned order specify the position of a point in a plane. Unless $x=y$, the symbol $[y, x]$ denotes quite a different point. This simple geometrical illustration is enough to shew that in pure algebra, quite apart from geometry, a pair of numbers (or indeed a whole row of n numbers) in an assigned order might be considered as a single entity A. Such an A is sometimes called a vector (if $n>1$), but it is a special case of a matrix of rank one.

Yet, curiously enough, the more natural set of numbers to consider as a compound unit in algebra is not a row so much as a *square* arrangement of numbers. Nine numbers put in square formation, three by three, are what Cayley called a matrix of order three. Cayley first saw the value of treating it as a single magnitude. The reason is this: that matrices may be added, subtracted, or multiplied together and the result is always a matrix. This is not entirely true of vectors.

As a square is a special case of a rectangle, one may substitute for the idea of a square matrix that of a rectangular matrix of mn numbers, arranged in m rows and n columns. The author has taken this as his leading idea throughout the series of volumes, the third of which we have now reached. But the arrays

$$A = \begin{matrix} 1, 2, 3 \\ 4, 5, 6 \end{matrix} \qquad B = \begin{bmatrix} 1, 2, 3 \\ 4, 5, 6 \\ 0, 0, 0 \end{bmatrix},$$

show that the oblong case is really included in Cayley's square, since the actual properties of matrix A and matrix B are effectively the same.

The B matrix here may be extended to the fourth or higher order simply by fixing columns and rows of zeros to the right and below the existing square. All such matrices share with A the same rank: it is the *rank* of a matrix which is its most important feature. The rank of A or B here is two, and in general cannot exceed the smaller of m and n.

The work of which the bare elements have just been explained is founded on original ideas of three of our countrymen—Cayley, Sylvester, and H. J. S. Smith—and it dates from about seventy years ago. As so often happens in mathematics, work started in England has been brought to fruition abroad. So the work of Cayley was advanced almost out of recognition by Frobenius, and that of Smith by Weierstrass. Sylvester, who foresaw an important future for matrices, outlined a programme which has been systematically adopted by Prof. W. E. Cullis, who has done a real service to the mathematical world by carrying it out in all its breadth and detail.

The present book runs to seven hundred pages, yet it is only part of volume three. It is conceived in a spacious, leisurely spirit. There is something portentous in the massiveness of the structure. The author believes in his thesis, but is in no hurry to convince the sceptic or the ignorant. He promises in volume four a wealth of practical applications to analytical solid geometry, the theory of groups, dynamics, and the like, which will justify the patient elaboration of the preceding algebra. Everything is thoroughgoing and sound, and in fact volume three covers a larger field than its title implies. It is the only really complete account, in the English language, of many fundamental facts of algebra bearing on polynomials, factors, eliminants, and so on.

The book deals with three great branches of the matrix theory, as grouped round the conceptions of (1) *potent divisors*, usually called invariant factors (*elementarteiler*), (2) *commutants*, and (3) *invariant transformands*. The first of these is the difficult general theory governing the classification of algebraic systems illustrated at their simplest by the conic or the quadric surface, or a dynamical system of small oscillations. The second and third of these are bound up in the study

of the respective equations

$$AX = XB,$$
$$AXB = X,$$

where A, B, X are matrices and X is the unknown quantity. Bearing in mind that ordinary algebra is the study of the simplest possible matrix, where $m=n=1$, we have a clue to the interesting general case. Non-zero solutions exist provided A and B satisfy a specific condition analogous to $A=B$ and $AB=1$ respectively, for this simple case.

Incidentally, a problem of Frobenius, to find the square root of a given matrix, is fully discussed.

The treatment of the work brings out forcibly the propriety of thinking of variables X and constants A in a relation

$$f(X, A, A', \ldots) = 0,$$

where $X, A, \ldots$ are matrices. The reader is brought to see how far-reaching are the ordinary conceptions of elementary algebra, such as the notion of solving an equation.

The book is not easy reading, in spite of the exceeding care taken to explain or prove everything. The reason is that the formal general case precedes special instances. Algebra is peculiarly adapted to the converse use: a chess board of nine or sixteen squares suggests most of the properties of a chess board of n^2 squares. Also several crucial results are disguised in small print.

The book has been carefully printed and contains few mistakes: one is only sorry that the Cambridge Press is unable apparently to do it full justice by returning to the use of the quality of paper or ink, or both, which go to make the first volume.

It may be added that the second name in the title is relatively unimportant in this volume. A determinoid bears to the rectangular matrix the relation which a determinant bears to the square matrix.

We are under a real debt to the distinguished author for this latest instalment of a mature and suggestive work, and we look forward to the promised further developments with interest.

Our Bookshelf.

Problems of Philosophy: an Introductory Survey. By Prof. G. Watts Cunningham. (Modern Thinkers' Library.) Pp. xxi+453. (London, Calcutta and Sydney: George G. Harrap and Co., Ltd., 1925.) 8*s*. 6*d*. net.

THIS is a useful book, with a modestly misleading title. When a writer introduces 'problems of' or 'studies in' this or that subject, he is commonly taken to offer his own particular theories on a limited group of more or less connected topics. Prof. Watts Cunningham has a less personal and more generous and catholic intention. He writes, broadly speaking, about all the problems that there are, and with the utmost objectivity and detachment. What he gives us is, in effect, a guidebook to contemporary metaphysics, as clear and simple as it can well be made, and so skilfully compacted that the intelligent use of a table of contents and an index will conduct an inquirer's finger straight to the sections relating to any one of the major issues of current interest, and let him find there just how the controversy stands, and why it is where it is. That is no small performance—it has meant selecting and correlating the significant 'tendencies' of endless recent discussion, indicating the historical background of each question, and making plain the cruces of each decision.

The plan of the book is simple. Part 1 defines, partly by contrast, the scope of philosophy and the nature of its distinctive method. Part 2 examines some central problems in the theory of knowledge. Parts 3, 4, and 5 trace the evolution from matter to mind, taking the widest possible survey of what is involved in these terms. Part 6 discusses the nature and status of our experiences of 'value.' This bare indication of contents is perhaps all that need be given; for, all through, the writer is little concerned to recommend a theory, but rather to expose the issues, to show what considerations are relevant and what are the implications. Plainly enough, Prof. Watts Cunningham's own sympathies are with the idealist tradition; but his survey is thoroughly impartial in spirit and in execution. Nowhere, in the nature of the case, does it cut very deeply; but it very well points the ways.

H. J. W. H.

The Physical Chemistry of Steel-making Processes: a General Discussion held by the Faraday Society and the Iron and Steel Institute, June 1925. Pp. 167-296. (London: The Faraday Society, 1926.) 8*s*. 6*d*. net.

As Dr. W. H. Hatfield has said in the discussion before us, "there is to be found in this collection of papers by far the most weighty and valuable treatment of the subject of furnace reactions that we have had." Almost every phase of modern steel-making is dealt with, and, although the symposium reveals, as the chairman, Sir Robert Hadfield, pointed out, the many important gaps in our knowledge of the reactions which take place at these high temperatures and of the physical data necessary for their elucidation, the general feeling after reading the present volume will be that a distinct advance is being made in this important scientific and industrial subject.

The paper by McCance on "Balanced Reactions in Steel Manufacture," a continuation of earlier work by the same investigator, represents probably the most important single contribution yet made to the subject. Experimental confirmation on an industrial scale is necessarily a slow process, and there are clearly many points on which such proof is required, but the excellent manner in which all the threads hold together and the agreement with experimental fact, so far as has yet been found, offer good reason to believe that in time the confirmation will be obtained. "A Study of the Reactions of the Basic Open-Hearth Furnace," by Mr. T. P. Colclough, is another outstanding contribution. His contention that the influence of temperature is definitely subordinate to that of slag composition is of fundamental importance. Among the other papers,

that on the reactions in the electric furnace, by Mr. F. T. Sisco, and another dealing with the general physico-chemical aspect of steel-making, by Mr. A. L. Feild, are well deserving of mention. To all those interested in any degree in the chemistry of the manufacture of steel, the volume is of the utmost importance and will be read with the greatest interest. F. C. T.

Science: an Introductory Textbook. By E. J. Holmyard. Pp. x+230. (London and Toronto: J. M. Dent and Sons, Ltd., 1926.) 4*s*.

MR. HOLMYARD is well known as one of the most active and vigorous exponents of the humanistic school of science teaching, and his viewpoint finds complete expression in this very entertaining and instructive volume. We could wish for nothing better than that the scoffer at the 'romance of science' should read it. For our part we found ourselves compelled to complete a first reading in one sitting. Mr. Holmyard's style is peculiarly happy and easy, and one feels that he thoroughly enjoyed his task. His object is to present science as a whole to the young beginner. He refuses to admit of barriers as between one branch of the subject and another, and in this he is right. Further, he has shown how it can be done. He enlists to his purpose the framework of the past—the Aristotelian scheme of the four 'elements' of air, water, earth, and fire, and after a historical introduction he deals with these one by one, and makes each the theme for a series of facts and phenomena of Nature. So we find simply and naturally interlocked a number of important and fundamental principles usually detached into separate 'subject' volumes. Finally, passing from the inanimate to the animate, the author presents a brief but interesting account of the phenomenon of life.

Naturally there is a serious danger of 'overdoing it,' but Mr. Holmyard has wisely preferred the errors of omission to those of commission. At the same time, we feel that the book would have been greatly strengthened by some short account of the astronomical scheme of the universe. In our view a general survey of science, even for the young beginner, definitely requires this, and its place is as pertinently at the beginning as is the study of life at the end.

The production by the publishers is, with the exception of some rather crude 'portraits,' very well done, and we have nothing but praise for a book that will commend itself to all interested in the teaching of science. I. B. H.

Life of Plants. By Sir Frederick Keeble. (Clarendon Science Series.) Pp. xii+256. (Oxford: Clarendon Press, 1926.) 5*s*. net.

AN initial embarrassment that confronts one who would become acquainted with the present achievements and aims of botanical science is the large number of books dealing with plants from which a choice may be made. The subject has been approached from so many points of view that curiosity is aroused as to wherein any new volume can differ from its predecessors.

Those who are conversant with the writings of Sir Frederick Keeble—who have read his fascinating "Plant Animals," for example—will not be surprised to find that the present book *is* different from those we already know. Excellent as many of the latter are in providing detailed and accurate information about plants, carefully and clearly though some of them are written, we have met with no book which succeeds in conveying to the same degree as does the present small volume the all-pervading importance of plants in the scheme of living things, or the wonder and romance of their activities.

The information is there also—the amount that has been packed into 250 pages is indeed astonishing—but the reader is given the impression of being led into a new country by roads which permit of ever more and more extensive views, the facts and arguments which border the road and define its direction never being allowed to grow into a hedge tall or dense enough to oppress the traveller or to obscure the surrounding prospect. Therein, perhaps, lies the one danger. The reader may be so enthralled by the scenery around him that he may be tempted to give insufficient attention to the details of the foreground. This omission can be made good, however, when the journey is repeated, as no doubt it will be more than once.

Few are the books which can justly claim to have completely fulfilled their author's hopes: fewer still those in which this or that modification would not seem an improvement to some reader. No doubt some will say that a rather disproportionate amount of space is given to Mendelism, or that the contrast between sporophyte and gametophyte phases, with the dominance of the latter in some groups of plants, has been insufficiently emphasised. Exception may also be taken by some to the wholehearted acceptance of hormones to explain the sensitive reactions of plants. Such, however, are but minor matters and do not affect the picture as a whole, which is surprisingly complete in view of the size of the canvass.

In the preface, the author pleads that we should judge leniently his failure to accomplish the task he set himself. If he has not succeeded in satisfying himself, he has earned the gratitude of his readers by giving them a delightful and stimulating book.

Comparative Philosophy. By Paul Masson-Oursel. (International Library of Psychology, Philosophy and Scientific Method.) Pp. vi+212. (London: Kegan Paul and Co. Ltd.; New York: Harcourt, Brace and Co. Inc., 1926.) 10*s*. 6*d*. net.

"COMPARATIVE PHILOSOPHY," by M. Masson-Oursel, gives the impression of a compilation. There is an introduction by Dr. Crookshank, a notice that Part II. has been translated by V. C. C. Collum, and a dedication to M. Lévy-Bruhl, whether by author or translator or editor does not appear. The book itself deals largely in generalities and is interspersed by a long table of comparative chronology and various bibliographies. There is nothing peculiarly original or even striking in the actual matter of the book, and now and then we come on fairly long quotations from the Greek which are left untranslated, although the book is scarcely designed to appeal only to scholars.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Classification of Research Work.

IT has often been found difficult to discriminate between the different classes of work carried on by research laboratories. This difficulty is intensified when, for such purpose as the founding of an industrial research association, it becomes necessary to explain these differences before persons to whom such work had previously been an unknown quantity. In these circumstances the lack of an exact terminology can cause much confusion; three members of a committee can use the expressions 'fundamental,' 'pure,' and 'applied' research, when all three may nevertheless wish to imply the same thing. Such explanatory terms as 'deep-digging' and 'trouble-curing' are less unmistakeable, but they fail to convey shades of meaning.

One grouping which served a useful purpose was made by separating investigation from research proper. This gave the successive steps of pure research, fundamental research, applied research, investigation, invention, and routine. Here a distinction was intended to be drawn in the second instance between the pure research of a university laboratory, and research which is just as free to pursue its studies to any depth or intensity, without regard to their ostensible usefulness, provided only that they are restricted to material offered by the industry concerned. However, the nomenclature employed was confusing, but the writer eventually realised, while assisting to explain these meanings, that the conception of 'restriction' could be used to provide a very tolerable classification which was implicit in the whole discussion of the topic. Such a classification is almost obvious when research work is looked at from the organiser's view of an industrial research department, with its conjoint laboratories, workshops, and manufacturer's plant.

This classification may be illustrated by the mechanical analogy of degrees of freedom, such as those of a three-point support. The three essentials of any research for our present purpose are the Method, the Subject, and the Aim. Accordingly, as the research worker is left free to pursue his own course in each of these respects, or in so far as he is restricted to a limited choice of their possibilities, so we obtain eight separate classes of research activities, covering a very wide range.

The fundamental relation of the experimental method to the advancement of natural knowledge, observed by Francis Bacon, evidently sets the Method in a position of superiority over the other two. Consequently, such work as is done with its methods under restriction is, speaking scientifically, of a low order; such is the plain routine of works-control laboratories, or of a testing-room. On the other hand, the university laboratory is potentially unrestricted—finance excepted—not only in its methods, but also in the subjects studied, and in its aims; it is free in all three degrees, to use mathematics or glass-blowing, to study nebulæ or tadpoles, and to take its aim no closer than at the advancement of human knowledge. The testing-room is not only restricted to quick routine methods in making its tests, as also in the study of its statistical data, but its subject matter is restricted to such material as is manufactured or used in its own factory, and its aim is equally restricted to narrow and well-defined ends. Between these two lie six other possible classes, and it is interesting to see that they do actually correspond to most of the recognisable classes of research work. We will briefly examine them in regular order, though the reader will best draw his own examples out of his own experience.

(*a*) FREEDOM IN METHOD, AIM, AND SUBJECT.—As already noted, this class is indubitably pure research, typified by that of the university.

(*b*) FREEDOM IN METHOD AND AIM, BUT RESTRICTION IN SUBJECT.—This is what the most enlightened industrialists imply by the term 'fundamental research.' It consists in purely scientific study of such material as possesses industrial importance, and is undertaken to broaden the basis of knowledge upon which effort ultimately rests. A determination of the chromosome numbers in species of Gossypium for the cotton industry will serve as an example.

(*c*) FREEDOM IN METHOD AND SUBJECT, WITH A RESTRICTED AIM.—For this class we might cite most of the work done on behalf of public health, which has one definite aim, though it studies mosquitoes or abattoirs, and uses statistics or string galvanometers.

(*d*) FREEDOM IN METHOD ONLY; AIM AND SUBJECT RESTRICTED.—The everyday research of most industrial laboratories falls into this class, which corresponds to the 'investigation' mentioned previously. It aims to effect paying improvements in specified materials and processes.

The next three classes are all restricted in the methods they may employ, and only possess freedom in the minor degrees. It will be seen that the latter are not in themselves sufficient permanently to characterise work as scientific research, and the examples are correspondingly vague. It is not in human nature to study without some speculation as to 'the good of it,' which provides an aim and alters the class. These three may be termed the 'unstable classes,' where true research merges into technicality, and 'gadgeteering.'

(*e*) RESTRICTED IN METHOD, BUT FREE AIM AND SUBJECT.—The usableness of a new discovery is investigated, such as Röntgen's rays, or the emission of electrons from a hot wire.

(*f*) RESTRICTED IN METHOD AND SUBJECT, BUT FREE TO ANY AIM.—This class might be termed that of intelligent technical benevolence. It is obviously a temporary phase through which much research passes in the course of its development.

(*g*) RESTRICTED IN METHOD AND AIM, BUT FREE IN ITS SUBJECT.—Most patented inventions deal with some particular way of achieving something; the invention itself may be applied to many different industries.

The remaining class is again clear-cut in its severe limitations.

(*h*) NO DEGREES OF FREEDOM.—Testing rooms; works-control laboratories; such routine work as that done by junior assistants.

If it be agreed that these classes cover the whole range of pure and applied research, and that they differentiate between types of research which are not easily distinguished otherwise, it remains to provide them with terminology. Having regard to the varied meaning which has already been given to most of the available English words, it is perhaps better not to attempt to name each class, but to specify it when need arises as 'completely free (or restricted),' or else as 'free (or restricted) in (one respect) only.' This

covers all the eight descriptions, if only one function is specified in the latter form.

For written notation we can use capitals and small letters. 'The MSa class of research' would be our class (*c*) above. It is for this convenience that the words subject and aim are used instead of material and object, or subject and object.

Using these notations it is possible to avoid a great deal of ambiguity when industrial research is under discussion, whether inside or outside the ranks of scientific workers. Further shades of meaning could of course be obtained by defining the amount of restriction, beyond the bare positive and negative here used, but it seems quite needless at present to do so.

W. LAWRENCE BALLS.

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Science and Psychical Research.

PERHAPS I may be permitted to offer a few comments on Dr. R. J. Tillyard's article under this heading in NATURE for July 31. Dr. Tillyard's sympathy for the scientific men who take up the study of psychical research, and thus, as he complains, 'lose caste' and undergo persecution from their fellows, may appear pathetic, and his stated determination, in spite of all consequences, to join the noble army of martyrs, may even seem heroic. He may take comfort, however, in the reflection that, after all, Crookes's spiritualistic activities did not prevent him from attaining to that highest of scientific positions, the presidency of the Royal Society, nor to-day does Sir Oliver Lodge cease to remain highly honoured amongst all scientific men for his physical investigations, and especially for his pioneer work in wireless telegraphy, nor does he cease to be in the greatest request as an exponent of the most recondite theories in modern physics amongst all the best-known scientific societies and institutions.

Dr. Tillyard appears to be surprised at the attitude towards spiritualism adopted by most scientific men, but surely this is to be explained by just such expositions of the subject as Sir Arthur Conan Doyle's "History of Spiritualism." As Dr. Tillyard himself admits, psychical research is therein "most certainly very unscientifically handled." Indeed, this so-called history is no more a scientific book than its imaginative author's recent spiritualistic novel. It is replete with what has been rather aptly described as 'determined credulity," and, like most of the fantastic and amazing literature that emanates from psychic bookshops, it trades on the credulous side of human nature, and especially on the emotions of those who, having lost friends who were dear to them, are distressed at the uncertainty of the survival of human personality, and, like the drowning man in desperation will clutch at any floating straw.

Dr. Tillyard makes light of the fraudulent aspect of spiritualism, and says that fraud exists in all branches of human affairs. I can offer no opinion upon the suggestion of biological fraud to which he refers, but speaking for physics, with which I am better acquainted, I cannot remember any case of such a kind worth mentioning during my lifetime. On the other hand, the whole history of spiritualism simply reeks with fraudulent deception. There appears to have scarcely been a single well-known spiritualistic medium who has escaped criticism of this nature. The pages of Sir Arthur Conan Doyle's book are filled with the achievements of spiritualists against whom fraudulent practices have been alleged, as it would seem to the unbiassed critic, on very convincing grounds, and quite a considerable portion of the history is devoted to explaining away these unfortunate lapses, the explanation in some cases consisting of the amazing suggestion that though evidence showed that the medium did cheat on certain occasions, on other occasions no signs of cheating on the part of this particular medium could be discovered, and therefore the manifestations produced must be considered to be genuine!

The fact is that the whole basis of spiritualistic investigation, as usually carried out, puts a premium on fraudulent practices. The so-called mediums that appear to be requisite in order to conduct the experiments, seem for the most part to be persons of inferior intelligence and education. Most of them are also needy, and eke out a precarious existence by payments for their services, which payments will only continue so long as they succeed in producing extraordinary manifestations.

Imagine for a moment research in ordinary physics made under such conditions as these, with the physicist unable to carry out his own experiments and make his own observations without dependence on the aid of assistants whose interests were all the time to fake the experiments and thus obtain startling effects, assistants, moreover, whose fraudulent delinquencies when discovered were excused and explained away, as seems to be the usual practice in the case of mediums caught cheating. Could any one have confidence in the accuracy of physical investigations carried out under such conditions?

But, says Dr. Tillyard, "we who have seen these things done under conditions precluding deliberate fraud, are not fools, but in full possession of keen faculties." Does he not know, then, that the experienced medium, just like the expert conjurer, both of whom prescribe to a large extent their own conditions, will fool the observer, however acute and scientific, nearly every time? Did he never, when young, attend at Maskelevne and Cook's home of mysteries at the old Egyptian Hall in Piccadilly, and did he ever once find out how the marvellous phenomena there shown, admittedly by pure trickery, were produced?

How even the most distinguished scientific men can be deluded is evidenced by the well-known case of the "N" rays, for the discovery of which the French Academy of Sciences presented a gold medal to Prof. Blondlot, who, however, was neither a fraudulent medium nor a conjurer, but a well-known and highly respected physicist, who, as is now understood, was at the time of his discovery unfortunately afflicted by incipient insanity, from which he afterwards died. How the "N" ray myth was for ever exploded was recounted by Prof. R. W. Wood in NATURE, and is a case of genuine delusion that in the interests of truth should never be forgotten. It is a warning for all time demonstrating the extreme danger of accepting the objective reality of phenomena which, as is claimed, can only be observed, attested, or produced by particular individuals, such as so-called spiritualistic mediums, and not by all competent persons.

I have recently had some personal experience of spiritualistic methods which show how little reliance can be placed upon the support that Sir Arthur Conan Doyle gives to spiritualistic phenomena. Having read in the *Morning Post* that Sir Arthur had exhibited at the Queen's Hall a photograph purporting to be the ghost of the second Viscount Combermere, who was my uncle by marriage, I remembered that I had seen this photograph shortly after it was taken some thirty-five years ago, and that it bore no recognisable resemblance to the deceased Viscount, whom I had frequently seen and

whose genuine photograph I happened to possess. I therefore publicly challenged Sir Arthur Conan Doyle to reproduce in the *Morning Post* the alleged ghost photograph alongside the genuine portrait, whereupon he appears to have suggested to the editor of the *Morning Post* that the ghost photograph could not be reproduced for technical reasons. This assertion was promptly refuted by the *Daily Sketch*, which—I having meantime obtained a copy of the ghost photograph—reproduced with great perfection both this and the authentic portrait in the issue of that paper for May 28 last. There these reproductions remain as evidence that any one can consult, and as I think all sane persons will admit, form a complete exposure of this particular spiritualistic myth.

Ex uno disce omnes.

A. A. CAMPBELL SWINTON.

40 Chester Square,
London, S.W.1,
August 9.

I WOULD like to thank Mr. Campbell Swinton for his letter criticising my article on "Science and Psychical Research" in NATURE for July 31 last. With what he says on the subject of spiritualism I agree almost entirely; but I had hoped that my article drew a clear distinction between spiritualism and psychical research. Unfortunately, the two are evidently confounded in Mr. Swinton's mind, though they are as distinct as, let us say, astrology is from astronomy, or alchemy from chemistry. If a physicist thought of taking up astronomy, would he read up a text-book of astrology to gain his first ideas of the subject? Or if he desired to study chemistry, would he begin with a history of alchemy? Yet this is just what such a man would be doing who thought to find in a book like Sir Arthur Conan Doyle's the elements of psychical research. Let me recommend to Mr. Swinton instead the careful perusal of Prof. Charles Richet's work "Thirty Years of Psychical Research."

That I in any way make light of the fraudulent aspect of mediumship I must emphatically deny. I think that the last sentence in the concluding paragraph but one of my article supports this denial. Mr. Swinton's remarks about mediums and psychical experiments show an entire misapprehension of the essentials of the problem. Mediums may be good or bad, just like chemical balances or microscopes, Some of them are below the average level of intelligence, others greatly above it; some may be paid for their services (and why not, when, like everybody else, they have to live?), and some never take a penny for the whole of their life's work.

These things, however, are entirely beside the point. In psychical research the medium is not one of the experimenters, as Mr. Swinton seems to think, but takes exactly the same place as the spectroscope in the study of light, or the microscope in the study of minute forms of life; that is to say, *the medium is the instrument through which the phenomena become objective to the experimenters.* Usually the medium is in deep trance and knows nothing of what is occurring. The only difference between the spectroscope and microscope on one hand and the medium on the other is that one is a man-made mechanism, the other a living being (if, as many materialists aver, both are merely mechanisms, then this difference vanishes). It is easier to control the mechanism than the living being, and that is why more stringent precautions are required in psychical research than in other sciences. If a spectroscope is found to give untrue results, it is thrown aside and a more trustworthy instrument is substituted; if a medium is found to be fraudulent, then the genuine psychical researcher will not proceed with him, but will endeavour to find a more trustworthy one. The spiritualists may make his apologia if they wish; that is no concern of psychical research.

Of all the great scientific men who have patiently and untiringly studied these phenomena—Crookes, Lodge, Richet, Flammarion, Wallace, Barrett, and others—can Mr. Swinton name a single one who has not become convinced in the end of their genuineness? On the other side we have either (*a*) some few who, having met with a fraudulent medium at the start, have adopted Mr. Swinton's motto *Ex uno disce omnes*, and have concluded, *without further investigation*, that the whole business was fraudulent, and (*b*) the great majority of scientific men, who have never experimented in the subject at all, but some of whom, nevertheless, consider themselves quite competent to pass a hasty judgment upon it. My article was simply a plea for a more scientific and logical attitide of mind from this second class. *Ex uno disce omnes* may be good Latin but it is bad logic; the hasty generalisation from insufficient facts is still, as always, the curse of modern science. A great teacher once chose twelve disciples; one of them turned out a fraud and betrayed his master. *Ex uno disce omnes?* Were all the apostles frauds because of Judas' defection? Surely not! If we must have a Latin motto, let us have a logical one, such as *Humanum est errare*; then, remembering that this applies equally well to physics, biology, or psychical research, let us make our dispositions for the detection and elimination of fraud and get on with the work.

If Mr. Swinton is really in earnest in desiring to do this, I would advise him to get into touch with my friend Mr. Harry Price, director of the National Laboratory for Psychical Research, 16 Queensberry Place, S.W. 7, and make an appointment to see over the laboratory. If his inspection proves satisfactory, perhaps he might even care to go further and arrange to be present at a sitting with a genuine medium like Stella C., when he might succeed in discovering the real reason for the peculiar behaviour of the thermograph during the production of psychic phenomena accompanied by cold breezes.

R. J. TILLYARD.

Zurich, Switzerland,
August 17.

External Capillary Action.

WHEN a glass tube, 6·5 mm. in external diameter, 5 mm. in internal diameter and of any convenient length, one end of which has been drawn out into the form of a cone 55 mm long with a hair-like apex 0·1 mm. in diameter and a correspondingly small aperture (Fig. 1 (1)) is filled with water containing, say, 1 per cent. of caustic soda, and held with its point downwards at an angle of 35° above the horizontal, a minute stream of water issues from its aperture, turns round underneath its lip and ascends to a distance of 33 mm. on its outer side in the form of a series of minute, disconnected, elongated globules which appear to encircle it. In flowing upwards these globules gradually lose their identity, and finally coalesce with each other to form a substantial drop at a point where the diameter of the cone is about 2 mm.

The drop encircles the cone symmetrically when the tube is vertical, but hangs from its lower side, as shown in (2) when the tube is held at an angle. After the drop has attained a weight of about 0·0113 gm.

with the tube shown, it breaks away from the influence of the force which has been holding it, sweeps swiftly down the lower part of the cone, carrying away the ascending globules, and falls from its apex. Immediately afterwards a similar series of globules begins to ascend and another drop is formed and falls away like its predecessor, and so on continuously. The weights of the drops and the rate at which they are formed vary with the angle of the tube, the magnitude of its aperture, the form of the cone, the magnitude of the head, and so on. With the tube shown in (1) a drop weighing 0·0113 gm. was formed every 2 m. 20 sec. for 12 consecutive hours in one trial. (2) was photographed instantaneously while the globules were in the act of ascending the stem.

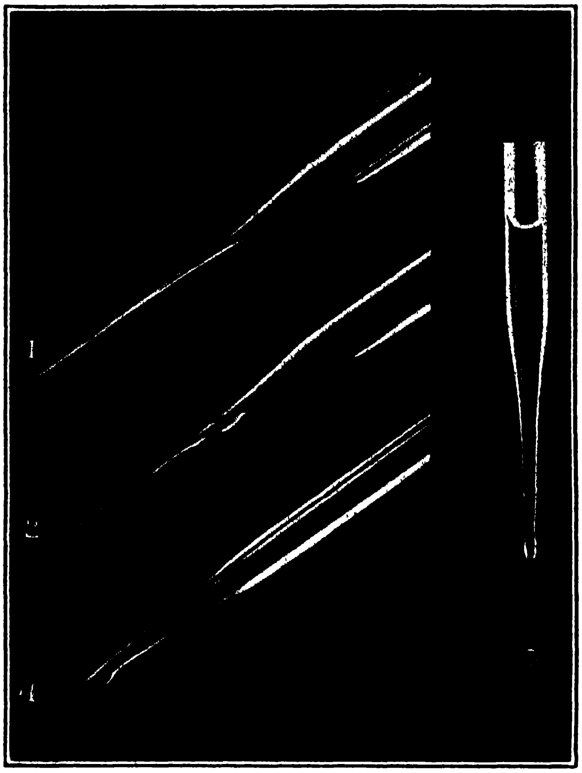

FIG. 1 - Scale, full size.

With some tubes, and some heads, the globules run up the wet surface of the cone so rapidly as to make it quite impossible to count their number; with others, and in different circumstances, they follow each other at distances of several millimetres apart at a comparatively moderate rate, according as the head is greater or less

(3) shows a tube held in a vertical position, (4) shows it held at an angle. In the former the drop encircles the cone symmetrically, in the latter it has gravitated round to the lower side.

The force which draws the water up on the *outside* of the cone in opposition to the force of gravity is obviously a function of the gradually increasing mass, and consequently of the gradually increasing attraction, of the cone.

The ratio of the weight of the salt to the weight of the decrement in the columns of solution of some salts is a *constant*. The ratio of the square root of the molecular weight of some salts (multiplied or divided by 1, 2, or 4), to the square root of the molecular weight of water multiplied by 4, is equal to the ratio of the weight of each of the same salts contained in its solution in water in a capillary column, to the weight of the decrement in water in the same column. W. GALLOWAY.

17 Park Place,
Cardiff.

Scattering of Electrons in Ionised Gases.

IN the November 1925 issue of the *Physical Review*, Langmuir published an investigation under the above title. From the collector characteristics of a mercury vapour discharge with a hot cathode, it was concluded that, in the tube, electrons must have been present with abnormally high velocities. Langmuir expressly mentions that with these discharges no oscillations could be found. In several experiments which were made by me in consequence of this publication, oscillations could in fact be detected. In accordance with my results, summarised below, it does not seem impossible that the observed "scattering of primary electrons" is always accompanied and caused by these oscillations.

1. A small metal plate, connected to a crystal detector, was placed in the immediate neighbourhood of a tube, similar to the one used by Langmuir. A galvanometer, shunted by the crystal detector, showed a deflexion at the larger current densities, when the electron velocities became abnormal.

2. To screen off the influence of the glass walls a tube was built in which the anode completely surrounded the filament. Only a few small holes (diameter 0·5 mm.) were drilled in it, in front of a collector. In this tube also the velocities became abnormal at the larger current densities, when again simultaneously oscillations could be detected. With appropriate values of emission, anode voltage, and pressure, these oscillations could be brought on a Lecher system. As wave-lengths, values from 40 cm. to 100 cm. were obtained.

3. A similar tube was used for experiments with argon. Here also, under favourable conditions, the Lecher system could be used and showed wave-lengths of the same order of magnitude.

4. With the argon experiments under certain conditions of pressure, etc., it was observed that the steady state of the discharge was only reached a considerable time after the anode voltage was switched on. During the first few minutes, neither abnormal velocities nor oscillations could be observed. Then suddenly the final state was reached in a discontinuous way. At this moment, the electron velocities became abnormal (max. about 20 volts), and simultaneously the detector galvanometer showed a deflexion.

5. Finally, the relation between the abnormal velocities and the distance through which the electrons had gone was investigated. With a tube as described under (2) above, the collector of which could be moved, it appeared that the electron velocities did not become more and more abnormal with greater collector distances, but the reverse happened. This also is not in agreement with the explanation suggested by Langmuir.

A more detailed description of the experiments will be published in the Dutch periodical *Physica*.

F. M. PENNING.

Natuurkundig Laboratorium der
N. V. Philips' Gloeilampenfabrieken
Eindhoven, Holland,
July 27.

On the Law of Radiation.

THE view of physicists on the question of distribution of black-body radiation is that the equipartition principle cannot apply to the problem, and that "each step from matter to ether, or back again, demanded the quantum factor, and does demand it wherever such interaction occurs," as Sir Oliver Lodge recently expressed it in NATURE, June 26, p. 891.

In the session of February this year I presented to the Pontifical Academy of Sciences, Rome, what I think is a new method of attacking the problem, on the basis of equipartition, with only the hypothesis that frequencies are distributed in the same way as velocities in Maxwell's law for gases

If we express the probability that frequency is between the limits ν and $\nu + d\nu$ by

$$\theta(\nu)d\nu = Ce^{-a^2\nu^2}\nu^2 d\nu,$$

where $C = \frac{4a^3}{\sqrt{\pi}}$, the corresponding number of oscillators will be

$$dn_\nu = N\theta(\nu)d\nu = \frac{4a^3N}{\sqrt{\pi}}e^{-a^2\nu^2}\nu^2 d\nu,$$

N being the total number in volume unit, and the density of energy in the emitting body, on the basis of equipartition

$$u_\nu d\nu = \chi TN\theta(\nu)d\nu = \frac{4a^3\chi TN}{\sqrt{\pi}}e^{-a^2\nu^2}\nu^2 d\nu.$$

Thence follows the expression for the emitted energy $k_\nu d\nu$; and assuming the Stefan law for totality of energy, it is easy to deduce $N = \frac{8\pi\sigma T^4}{\chi T c}$, σ being Stefan's constant, and therefore for k_ν the expression

$$k_\nu d\nu = \frac{4a^3\sigma T^4}{\sqrt{\pi}}e^{-a^2\nu^2}\nu^2 d\nu.$$

In order to calculate the constant a we transfer the expression for k_ν in the corresponding E_λ through the relation $E_\lambda d\lambda = k_\nu d\nu$ and introduce Wien's law of displacement. The expression for E_λ becomes

$$E_\lambda d\lambda \quad \frac{4a^3}{\lambda^5\sqrt{\pi}}\lambda T e \quad d\lambda,$$

where a is Wien's constant multiplied by $\sqrt{2}$

The law of distribution hence will be

$$F(\lambda,T) \quad \frac{4a^3\sigma}{\lambda^5\sqrt{\pi}}\lambda T e^{-\frac{\quad}{\lambda^2T^2}}$$

corresponding to Wien's condition, and containing only the Wien's and Stefan's constants. When λT is large the formula reduces to Lord Rayleigh's expression

The new formula agrees very satisfactorily with the measured energy distribution in the solar spectrum.

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The Electrical Polarity of Molecules.

ON attempting to correlate the electrical double-refraction (Kerr effect) of gases and vapours which has been measured by Leiser, Hansen and Szivessy, with the optical anisotropy of the molecules determined from observations on light-scattering, it is found that electrically polar molecules generally exhibit a Kerr effect which is very large in relation to their optical anisotropy. This indicates that the orientative action of the field on the molecule in such cases is chiefly due to the permanent electric doublet present in it, and is much larger than would be the case if the molecules were non-polar. In the case of molecules having an axis of optical symmetry to which the electric doublet is parallel, or is inclined at some known angle, it is possible to calculate the permanent electric moment from the value of the Kerr constant and the constant of depolarisation of the scattered light. Conversely, if the moment is known, the inclination of the electric doublet to the optic axis can be found. For example, in the case of the simple dipole molecule HCl, we may assume the optic axis to be parallel to the doublet.

The constant of depolarisation as recently measured by Ramanathan is 0·010, and the Kerr constant from the measurements of Hansen $0{\cdot}90 \times 10^{-10}$. From this, considering the orientative action of the field to be due only to the permanent doublet, we find its moment to be 1·06 electrostatic units, while if the orientative couple on the induced doublet is also taken into account as in the case of non-polar molecules, the value of the permanent moment comes out to be $1{\cdot}04 \times 10^{-18}$. The recent determination by Zahn from dielectric constant measurements gives $1{\cdot}03 \times 10^{-18}$, thus showing good agreement.

When the optical ellipsoid of the molecule has three unequal axes, measurements of the factor of depolarisation and of the Kerr constant are by themselves insufficient for an accurate determination of the electric moment. But if the moment is known from measurements of the dielectric constant, the data mentioned are of much assistance in fixing the position of the axis of the doublet. For example, if the Kerr constant of a substance is negative, we can assert definitely that the axis of the permanent doublet does not coincide with the longest axis of the optical ellipsoid. It is interesting to note in this connexion that, so far as is known, all substances having a negative Kerr constant are polar.

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Depth of Origin of the Earthquake of August 15.

THE earthquake of Sunday morning, August 15, was one of those for which no method of determining the depth of origin had been devised until recently, and offers an opportunity for applying that which was published in the *Quarterly Journal of the Geological Society* for February last. The extreme limits of the area over which the shock was felt appear to have been Llandrindod Wells and Blackheath, which are about 150 miles apart; the maximum violence seems to have just about reached the lower limit of VI° of the Mercalli scale, or an acceleration of about 150 mm./sec.² Applying the coefficients in the paper referred to, the resulting depth of origin is not far from thirty miles. This estimate is based on the newspaper reports and subject to correction when more precise data are available. The maximum acceleration may have been more than the figure adopted, the limiting value of acceleration, of a shock which is just sensible in England, may be less than the 20 mm./sec.² adopted, and either of these would lessen the resulting depth of origin. On the other hand, the description of the shock at

the limiting stations suggests that it must have been sensible even beyond them, and this would give a greater depth. Taking all these circumstances into consideration, it seems probable that the earthquake originated at a depth of some 25 to 30 miles, say 40 to 50 kilometres, below the surface of the ground.

R. D. OLDHAM.

The Groma: an Ancient Surveying Instrument.

A FEW weeks ago, while looking through some miscellaneous objects at the premises of the Egypt Exploration Society, I discovered a portion of a groma, an ancient surveying instrument, commonly used in Græco-Roman times for setting out straight lines and directions at right angles, in building operations as well as in land instruments.

There are several references to this instrument in the literature, but the only other specimen known was one unearthed at Pompeii in fragments in 1912. This was reconstructed by M. Della Corte and a model is in the South Kensington Museum. There is a representation of a groma on the tombstone of a Roman 'Mensor' found in the neighbourhood of Turin.

The portion now brought to light consists of two roughly shaped pieces each about 12 inches in length, formed of the centre rib of a datepalm leaf, bound together at the centres by a lashing of datepalm fibre, forming a loop for suspension. Near the ends of each piece are in-cuts to locate the plummet strings which were suspended from the ends.

So far as is known, this is the first specimen of the kind known, and special interest attaches to the fact that it came originally from Egypt, having been brought from the Fayum in 1899. Since then it has lain unrecognised among the Museum surplusage in the Society's basement. It probably dates from the Græco-Roman period and may be a tomb model.

The specimen has been acquired by the South Kensington Museum authorities and will shortly be exhibited there.

R. W. SLOLEY.

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The Absolute Density and Coefficient of Expansion of Silicon Tetrachloride.

IN a recent paper on "A Comparison of the Atomic Weights of Silicon from Different Sources" (*Jour. Chem. Soc.*, 1926, **128**, 1262) the density of silicon tetrachloride from different sources was determined by means of glass floats. These were calibrated at one temperature and used in the actual measurement at another, but in making the calculation we omitted to take into consideration the alteration in volume of the floats consequent on this change in temperature. After we had instituted inquiries for a trustworthy coefficient of thermal expansion for the 'Durosil' glass used, in order to correct the reported figures, we received a private communication from Mr. A. G. Milligan pointing out this omission, which leads us to take this early opportunity of publishing a provisional correction. Applying the probable value $14 \cdot 1 \times 10^{-6}$ for the cubical expansion of 'Durosil' to the data already published (*loc. cit.*), the mean density and coefficient of thermal expansion of silicon tetrachloride become $1 \cdot 481461 \pm 0 \cdot 000020$ and $0 \cdot 0014048 \pm 0 \cdot 0000022$ respectively. We hope to publish elsewhere a complete résumé of the densities, etc., when our inquiries have yielded a trustworthy coefficient of expansion for this glass.

It should be noted, however, that the application of this correction to the five densities in question makes no alteration in their relative magnitudes, and thus leaves unaffected the essential conclusion of our paper (*loc. cit.*).

P. L. ROBINSON.
H. C. SMITH.

Armstrong College,
Newcastle-upon-Tyne,
July 30.

The Movements of Molecules.

IN a very interesting little book on phosphorescence by T. L. Phipson, Ph.D., published in 1866, on p. 184 he says: "We have no proof that the molecules of bodies vibrate in straight lines; their motion is more probably circular. Indeed, my ingenious friend, M. Porro, has endeavoured to show the great resemblance which seems to exist between these molecular movements and those of celestial bodies; and it has been supposed by some philosophers that the molecules of matter are as distant from each other, in proportion to their size, as the planets themselves." "But in the present state of knowledge, all these considerations are premature."

Ignazio Porro (1795–1875) was a French physicist who made improvements in the binocular telescope, the telemeter, and other optical instruments. It would be interesting to know if he had any inkling as to the existence of moving particles or electrons in atoms. I have looked through the list of his published papers given in the Royal Society Catalogue, but did not see any titles which appeared to bear upon the subject; perhaps some readers of NATURE may know of some which do.

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Pernicious Grafting.

To reply fully to the question asked by Dr. Grabham in NATURE of July 17 would entail a much greater demand upon the space available than the subject would at present appear to justify.

A study of the question as set forth by Dr. Grabham immediately suggests to the practical cultivator that root control would remedy the evil: nobody expects the best results from peach or nectarine trees grafted on any stock unless systematic root pruning is practised, and from the tendency of the wild 'individuals' in Madeira to flower before the fall of the leaf one adduces the fact that there is a lack of sympathy between stock and scion; therefore root pruning might be the means of modifying the flow of 'incompatible' sap to the need of the cultivated variety at that period. Moreover, a cool moist condition of the soil during the winter being essential to successful peach cultivation, it may be necessary to adopt means of providing these conditions in Madeira, as well as a careful selection of root stocks.

W. M. MACDONALD.

14 Canongate,
St. Andrews, Fife,
July 23.

The Relation between Cultivated Area and Population.[1]

By Sir DANIEL HALL, K.C.B., F.R.S.

RECENT considerations of the problem of the capacity of the world to continue to feed its growing population appear to have begun with the late Sir William Crookes's address as president of the British Association when he discussed the ultimate curtailment of the wheat supply through exhaustion of the soil nitrogen. Crookes's views attracted little more than academic attention at the time (1898) because the great tide of wheat that was setting in from the newer countries still in the process of exploitation was barely slackening; moreover, Crookes had neglected a factor then imperfectly appreciated—the fact that land under any of the conservative systems of farming adopted in the old settled countries does not become exhausted. Generally speaking, a soil will remain itself indefinitely at a certain level of production. Latterly in Europe that level has been raised by the introduction of extraneous fertilisers. In his review Crookes predicted the development of the synthetic processes of bringing nitrogen into combination which are to-day rendering that prime element of fertility so abundant and so cheap.

Though we no longer fear the exhaustion of soils, of late years certain sociological considerations have revived interest in the old thesis of Malthus. Over-population and unemployment have become terrible realities in Great Britain and other countries; many States are finding themselves under pressure to maintain their standard of living against the intrusion of neighbouring races propagating recklessly down to the barest margin of sustenance. Again, various studies of the course of prices of wheat have led to the conclusion that before the War the real price was rising continuously, and that this tendency is manifesting itself again, however much the true sequence of prices has latterly been obscured by fluctuations of currency.

These considerations led Mr. Keynes to envisage the approach of scarcity: his attitude is very much a return to Malthus. On the other hand, Sir William Beveridge, addressing the Economics Section two years ago, dismisses this fear as regards the world at large; whatever may be the troubles in Britain, "the limits of agricultural expansion are indefinitely far." On the whole that seems a very safe proposition; it has been so amply fulfilled for the last hundred and fifty years—during the greatest expansion of population the world has ever known—that it would almost seem to be necessarily true, especially as it can be buttressed by agricultural experiments showing the enormous potentialities of production from the soil.

There is, however, one aspect of the case that appears to have received insufficient attention: the capacity of agriculture to provide food for the people depends upon the extent of land available as well as upon the pitch of cultivation. To what degree can the tuning-up of methods be made to compensate for a non-expanding acreage? The first step towards a more exact consideration of the problem may therefore be an estimate of the amount of cultivated land that is required to maintain one unit of population—man, woman, and child.

We may make our estimates by either of two methods—abstract or actual. The Food (War) Committee of the Royal Society adopted the figure of 2618 calories as representing the minimal daily energy requirement of one unit of the population, and calculated that the actual United Kingdom consumption in the five years 1909–1913 amounted to 3091 calories per head per day. An average English acre of wheat yielding 32 bushels will produce food, in the shape of wheat, flour, and pig obtained from the offals, of a calorie value of about $2\frac{1}{2}$ millions. As the average consumption was about 1·13 million calories per head per year, we arrive at the conclusion that one acre of wheat would support more than two head, the relationship being more exactly 0·45 acre to feed one unit of population. But this figure is of no service in our more general consideration. The yield of wheat of 32 bushels per acre is far above that of the wheat-producing areas, and is that of only a few selected countries growing but a limited acreage. It is again the produce of land under the plough, and is consumed in the main as a vegetable product.

The great areas of grassland have a lower output of energy than the cultivated land, and the conversion of vegetable into animal food, whether of natural or cultivated fodder crops, is always attended by a great waste of energy. In the most economic production of pig-meat or milk, the energy recovered is only about one-sixth of that consumed, and this represents the machine at the top of its efficiency. The longer period of beef production results in a recovery as beef of only one-eighteenth of the energy consumed, and in practice the actual wastage of fodder and feeding-stuffs doubles or trebles the inevitable losses by conversion. Moreover, just as man is not a vegetarian making the most of the mere sustaining power of the land, so he does not use the land for food alone, but also for drink, for wool and fibre and other industrial materials, and for amenities.

We shall not get far on the theoretical basis, and I have only mentioned it as indicating the order of the superior limit of the maintaining power of land.

THE UNIT OF MEASUREMENT.

We must approach the question in a more empirical fashion and endeavour to ascertain the existing relation between the land in use and the people fed by it. Taking again the estimates of the Royal Society's Committee, it concluded that the United Kingdom production of food for the five pre-War years was 42 per cent. of the food consumed; 46·7 million acres of cultivated land then produced 42 per cent. of the food consumed by a mean population of 45·2 millions, which works out to 2·5 acres to each unit of the population. This figure, however, is somewhat misleading in that it does not do justice to British agriculture, since our farming is to a considerable degree concentrated on the more costly elements of diet like meat or milk rather than upon cereals and sugar. For example,

[1] From the presidential address to Section M [(Agriculture) of the British Association, delivered at Oxford on August 9.

49 per cent. of the food production at home, as against only 24 per cent. of the imported food, consisted of animal products.

The importance of this relation between cultivated area and population is so great, and the calculations by which it can be ascertained are so approximate and subject to so many estimates of a speculative kind, that I may be allowed to set out various results obtained by different methods.

We may begin by comparing population and area of cultivated land for all European countries except Russia, to which we add the United States, Canada, Argentine, Australia, and New Zealand, as the white countries which are also the chief exporters of food to Europe. I exclude all oriental countries because in them the mass of the population possesses a different standard of living, and I have excluded the other South American States and the Union of South Africa and other African colonies because they all possess a very large 'native' population and their exports do not bulk large in the food account of Europe. We must recognise, however, that the errors in the calculation will be loaded on to one side, because all the unenumerated countries, Russia and the tropical lands, are to a greater or less degree exporters and not importers of food. However, with this proviso we find that in the States enumerated there are 464·1 million hectares of land under cultivation and a population of 481·5 million persons, or 2·4 acres per head.

In the United States about 356 million acres are in cultivation: from this may be deducted as producing exported materials, for cotton 24, for wheat 16, for maize 2, for meat products 22 million acres, or 65 million acres in all. Other products are exported but may be regarded as balanced by imports, so that we find 291 million acres of cultivated land devoted to supplying a population of approximately 112 millions, or 2·6 acres per unit of population.

France we know is a country that is largely self-supporting; it has a population of 39·3 millions and 36·3 million hectares under cultivation. To this acreage we must add 0·9 million for imported wheat, 0·5 for other cereals, and 1·1 for imported meat; the exports of wine and fruit we may regard as balanced off by other imports. The net result is approximately 1 hectare, or 2·4 acres, for each head of the population.

A similar calculation applied to Spain, a country in the economy of which neither exports nor imports of food play a large part, gives more than 4 cultivated acres per unit of population; but then the so-called 'cultivated' land includes a considerable proportion of mountain pasture of a very low order of productivity. On the other hand, Denmark, with the most highly developed agriculture of all countries, shows a production well above the average. A much closer calculation of production is possible for Denmark than for other countries—the data are set out in Mr. Harald Faber's paper before the Royal Statistical Society in 1924. Denmark is a country exporting agricultural produce chiefly in its most costly form as meat, butter, and eggs, but the means for equating the export against consumption is supplied in Mr. Faber's paper by the reduction of production and imports to food units. Making the necessary corrections for imports, it would appear that for the years 1909–1913 the population of Denmark was maintained on 63 per cent. of the production of her own land, or 1·82 acres per person.

Putting the various estimates together, we arrive at the conclusion that under the existing conditions of agriculture among the Western peoples, it requires something between 2 and 2½ acres of cultivated land to supply the needs of one unit of population living on the standard of white peoples.

We may confirm this estimate by a consideration of the growth of population during the last century. Between 1800 and 1920 the number of the white peoples increased from about 200 millions to about 700 millions. Data, however, for the land under cultivation in 1800 are very imperfect, and again there was another factor of improved agriculture which came into play in the first half of the nineteenth century. If we take 1870 as our jumping-off point, we may estimate the increase in the white man's numbers up to 1920 as approximately 225 millions. During the same period the addition to the cultivated lands in Europe, United States, Canada, Argentina, Australasia, and South Africa, the countries which have provided the white races with food, has amounted to about 450 million acres. Again we reach a relation between cultivated land and population of between 2 and 2½ acres per head.

This brings me to the central point of my argument, that an increase of population is in the first instance dependent upon an increase in the area of cultivated land. The expansion of the white peoples in the last century was an event unprecedented in the world's history, and was achieved only because of the vast areas of unoccupied land, chiefly in the Americas, which suddenly became available for settlement through the power conferred by the railroad, the steamship, and modern weapons. It will be noticed that the population of Europe previously had become comparatively stable, even as it has become approximately stabilised in France at present—the expansion came with the opening up of the new lands and in proportion to the amount that could be settled.

ENERGY VALUE OF PRODUCE.

Accepting as a basis for further discussion that under the present system of agriculture something more than two acres of new land will have to be brought under cultivation for each unit of increase in the population, we may examine if any means exist of modifying this relationship before considering its consequences.

I have already suggested that a vegetarian diet is the more economical of the resources of the soil, and that meat and all animal products like milk and eggs are produced with an expenditure of energy which may be so low as seven but also so high as twenty times the energy available from them. It is true that to a certain extent the animal will utilise material otherwise of little service to man, like milling offals and low-grade fodder crops—roots, hay, or straw. None the less, if the maximum of population supported by a given area of land is the objective, vegetarianism becomes increasingly necessary, as we see among the crowded populations of India and China. At the same time, the tillage of lands now given up to the grazing of animals becomes possible because of cheapness of labour resulting from a redundant population. Most

of the beef and mutton supply comes from land left untilled because of the costliness of labour relative to products; the meat may represent a very low level of production from the land and yet a high cash return for the labour expended. Hence the apparent paradox of grazing being general in Middlesex because of the proximity of London.

Another item of waste which would have to be eliminated in case of stern necessity is the conversion of potential food into alcoholic drink. Great Britain ferments the equivalent of one and a half million acres of barley. France devotes 4,000,000 acres, nearly 4·5 per cent. of her cultivated area, to vineyards. Without going so far as to say that beer or wine possesses no food value, it is certainly not half of that which could have been grown from the land thus used for the production of drink. In such matters it is vain to prophesy, but I cannot help feeling that the race (not individuals) which cuts out meat and alcohol in order to multiply is of the permanent slave type destined to function like worker bees in the ultimate community.

INTENSIFICATION OF PRODUCTION.

The second question that merits very careful consideration is whether the current agriculture cannot be intensified so as to bring about a great increase of production from the existing area of cultivated land. A cursory examination of the average yields of our chief crops in different countries shows what an immense potential increase of production is here open. The average yield of wheat (1921 to 1924) for all the countries of the world collecting statistics was 13·2 bushels per acre; the average yield in Denmark for the same period was 41·4 bushels per acre—more than three times as much. Of course the area devoted to wheat in Denmark is about 200,000 acres in all, or 3 per cent. of her arable land, whereas the wheat acreage of the world amounts to about 250 million acres. The mass production of wheat in the world is from countries of low yield; more than half is grown in countries in which the average yield is less than 13 bushels per acre.

It is from these countries with the low yield per acre that wheat is exported, and their production determines the world market, with the consequence that wheat production has been increasing in these and similar countries, while it has been shrinking in the European countries with a higher yield per acre.

The dominating factor has been cost of labour; speaking broadly, it may be said that increased yields per acre are associated with higher expenditure per bushel for labour, and the great wheat-producing countries with a low yield per acre are the countries with a correspondingly high yield per man employed. It may be estimated that in England a man's labour produces about 960 bushels of wheat, in Australia 1500 bushels. A more exact comparison shows that in England the labour cost amounts to 1*s*. per bushel of wheat, against 8*d*. in Canada; this with an average wage rate of 30*s*. to 36*s*. a week in England as compared with 60*s*. in Canada.

All this goes to show that intensification is only to be purchased at the cost of labour, and that in the past, extending the cultivated area has been a cheaper way of getting the wheat required by the world than higher farming.

This general statement, however, does not tell the whole story; particularly it disguises the intensification of yield that may be obtained without a commensurate increase of labour. For example, the introduction of more heavily cropping varieties, originated by the skill of the plant breeder, may add greatly to the production from a given area without increasing costs other than those of harvesting and marketing.

One must not, however, expect too much of the plant breeder. Over the greater part of the cultivated land of the world the gross amount of production is limited by external factors such as water supply, temperature, available fertility of the soil, etc. For example, the wheats and barleys grown in England had long been subjected to selection and improvement before the scientific methods of plant breeding were evolved, and the further steps in improvement are going to be neither big nor easily won, depending as they do upon altering what Dr. Beaven has called the migration ratio, whereby the plant will convert more of the material obtained from the air into useful grain and leave less as straw. The chief opportunities, in fact, lie in the elimination of susceptibility to disease or destruction by frost, or general tenderness of constitution, by which means the range of the high-yielding cereals, or even of cereal growth at all, may be enormously extended.

ARTIFICIAL FERTILISERS.

The general enhancement of production by processes which induce improvements of the water supply or the temperature, as by irrigation and drainage, soil amelioration, cultivations, etc., suffers from the disadvantage of calling for labour, until it may prove far more costly than the increased produce can repay. Fertilisers appear to offer more promise. It may be recalled that the general level of production from English land was raised by nearly 50 per cent. between 1840 and 1870. At the beginning of the period the average yield of wheat was of the order of 20 bushels per acre, this being the crop the land was capable of maintaining under a conservative rotation with no extraneous source of fertility. But between 1840 and 1870 artificial fertilisers were introduced and became a generally accepted part of British farming, with the result that the yield of wheat had risen to about 30 bushels per acre, though no other marked change in the routine of cultivation had been adopted during the period. The employment of fertilisers still lags far behind the opportunities of employing them to profit.

The various processes of bringing atmospheric nitrogen into combination, to which the War gave such a stimulus, are now being developed on a vast scale in all civilised countries, and will result in an almost unlimited increase in the amount of nitrogenous fertiliser available at low prices compared with the prices of agricultural produce. Here at least is the opportunity for another step up in production from our cultivated lands comparable with the progress that was made between 1840 and 1870. It is not all

plain sailing; the farmer has to study carefully where an increased supply of the cheapened nitrogen can be most suitably applied to his land and what changes in his system of cropping are demanded. The plant-breeders' art is needed; on most of our land any great enhancement of growth of cereals brought about by the use of nitrogenous fertilisers is attended with the danger of lodging. Few of our cereals possess stiff enough straw to remain standing on a soil enriched to the degree even that is reasonably practicable to-day. Thus the more immediate outlet for the new fertilisers would appear to be the fodder crops which are convertible into meat and milk.

In the solution of the main problem under discussion—the possibility of intensification of production from the existing farmed land to meet the needs of a growing population—the development of the synthetic nitrogen fertilisers must play a dominant part. Crookes's prophecy is coming true.

THE ECONOMICS OF PRESENT-DAY AGRICULTURE.

The present annual increment in the white population may be estimated at about five millions. This, taken alone, would necessitate the taking into cultivation of twelve million acres of new land every year. No process of the kind is going on; indeed, for many crops there has been an actual shrinkage in the acreage since the War. The shrinkage is doubtless no more than a temporary matter, the back-water of the wild fluctuations of prices and values brought about by the War, but it does not promise well for that continued expansion of the cultivated area which the still growing population demands. Indeed, we may detect a new influence at work, the growing disinclination of the civilised peoples to continue in agriculture because of its small and uncertain returns as compared with those of other occupations.

The flight from the land is manifest equally among the wage-earners of large-scale agriculture and among the peasants or family farmers in whose hands resides the greater part of the cultivation, whether in the old settled countries of Europe or the newer exploitations of America. Again and again it must be urged that the determining cause is economic; for the last half-century, save for the abnormal War years, farming has not paid a return on the capital and labour expended comparable with that obtainable elsewhere. It has been said that even the American farmers of the Middle West, who cut prices for all the world, made no profits during the last half-century except those derived from the accretion of land values; and the peasant farmer, who counts neither the capital he has in the business nor the hours of labour he gives to his land, who in Europe is held to the land by secular tradition, finds agriculture unattractive so soon as the growth of industries and the spread of communications render an escape possible. If not the peasant himself, at least the sons look for an easier and less exacting mode of life.

At this stage it would be impossible to begin to diagnose the causes of the comparative unprofitableness of agriculture. Fundamentally it is due to the weakness of the farmer as a commercial unit; the smaller the farmer the more ruthlessly does he compete with his neighbours and reduce prices to a bare level of sustenance for his long hours of labour. Even the large farmers who can put into practice some of the economies of an ordered industry are helpless against the large commercial organisations which pass on their produce to the customers. Always there is the peasant farmer to cut prices.

I cannot, however, pursue this issue. I return to my original text: that if we are to continue to feed the growing population of the world on the present methods a continued expansion of the cultivated area is required; new land is called for year after year. I cannot see where this new land of the necessary quality is to be found in quantities commensurate with the immediate demand. Doubtless the white races will insist on maintaining their rising standard of living and will apply deliberate checks to their fertility, a process we already see in action. But the restriction of increase will not take effect all at once even under economic pressure, and the danger lies in the period preceding the comparative stabilisation.

As it cannot be supposed that the development of the civilised races can be allowed permanently to be checked by lack of food when food is obtainable, it follows that resort must be had to the intensification of production from the area already under cultivation. The means for that intensification are already in sight, more will be supplied with the advancement of research. Intensification, however, is in the main attended by a higher cost of production, and movement in that direction is likely to be slow until it is stimulated by a rise of prices. Organisation will have to be introduced into the industry, and it may be expected that organisation will take one or other of three forms. The farmer may be left as the producing unit, but his methods will be strictly controlled and standardised by the great selling corporations that handle his produce, and these corporations may be either commercial ventures or co-operative associations of the farmers themselves. The co-operative venture appears to imply an even more rigid discipline of the individual than that imposed by the capitalist firm. Alternatively, the capitalist may venture upon the direct exploitation of large areas of land and industrialise farming as he has industrialised other producing businesses. But capital will only be tempted back to farming, whether for the organisation of the business or even to enable the individual to take advantage of the possibilities of intensification, if prices rise to a definitely remunerative level.

I hope I have given reasons for supposing that prices must rise, because the surge in population set up by the unprecedented extension of the cultivated area last century cannot all at once be checked, whereas the new land still available is either inadequate in amount or unsuited to cheap production by the old methods. How close at hand the period of pressure may be it is unsafe to prophesy, but it may be agreed that pressure is sooner or later inevitable and that one of the biggest problems before the world at present is to prevent the pressure developing suddenly or becoming unbearable. The intensification of production is the only remedy, and, again, the only means of rendering intensification practicable is the continued pursuit of scientific research.

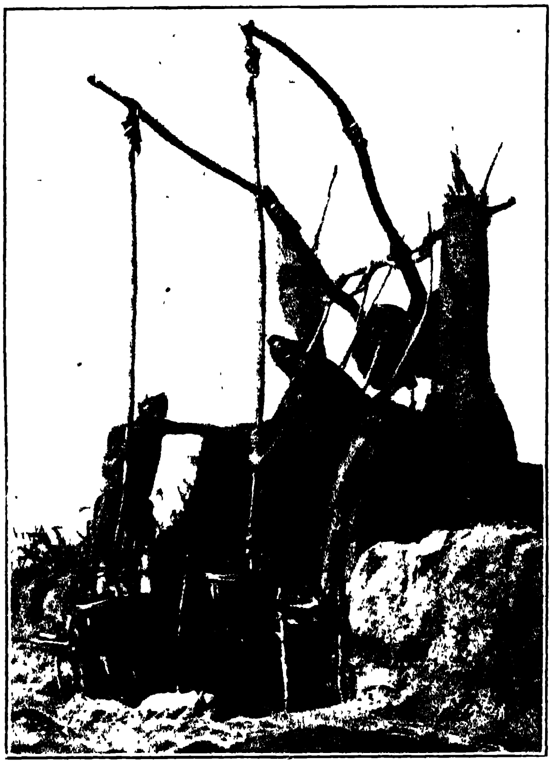
The Rate of Work done with an Egyptian Shadouf.

By Dr. J. S. HALDANE, F.R.S., and Dr. YANDELL HENDERSON.

THE shadouf is a man-power apparatus which from time immemorial has been used in raising water from the Nile or from canals, etc., for local irrigation purposes in Egypt. Great numbers of them can be seen in operation throughout all parts of Upper Egypt, and there appears to be little tendency towards their displacement by power-driven pumps.

With a shadouf water is lifted, usually about ten or eleven feet, in a goat-skin bucket, and delivered into a water-channel at the higher level. During low Nile in Upper Egypt, three shadoufs, or pairs of shadoufs, working in series, are commonly employed to lift water from the Nile level to that of the adjoining land. The bucket (Fig 1) is carried on a wooden hook lashed to a light upright pole of tamarisk wood. This pole is attached at its upper end by rope to one end of a light beam made from a branch, or two branches lashed together, of acacia wood, which is sufficiently strong and rigid to support the weight of the bucket without much bending. At about three-fourths of the distance to the lower end, the beam is pierced by a hole through which passes a wooden pin on which the beam is pivoted. This pin is suspended by short cords from a stout wooden bar, of which the ends rest on two upright pillars consisting of either wood or maize-stalks and dried mud. Round the other end of the beam is plastered a globular mass of dried mud and chopped straw to serve as a counterpoise. Acting on the short end of the beam it is sufficiently heavy (about 230 lb.) to raise a bucket-full of water suspended at the other end.

The bucket consists usually of goat-skin, although light metal buckets of similar size and shape are used in some places, and is held open by a wooden ring about sixteen inches in diameter, and has a cross-bar to which the wooden hook is attached. Since the counterpoise pulls up the water, nearly all the work done by the man is performed in pulling downwards the upright pole carrying the empty bucket. During this operation his body becomes bent to extreme flexion, and has to be straightened as the bucket ascends. He has also to tip the bucket when it reaches the higher level, and just as it reaches the lower level he gives the pole a slight jerk, so as to make the bucket enter the water edgewise, and thus fill instantly.



1.—P... f shadoufs working in parallel. After a photograph by Messrs. Gaddis and Seif, Luxor.

During a recent visit to Egypt we took the opportunity of measuring the rate of work done in raising water by means of a shadouf. All shadoufs appear to approximate very closely to the figures here reported. We found that the bucket holds about 60 lb. of water when nearly full, as in the lift, and is raised 11 feet $6\frac{1}{2}$ times a minute, or up to 8 times a minute for a correspondingly less elevation. Thus the work done in raising the water is about $60 \times 11 \times 6 \cdot 5 = 4290$ foot-pounds per minute, or nearly 600 kilogram-metres per minute. Two men, working alternately for about an hour at a time, are employed on each shadouf, and each man works for a total of about 6 hours daily. Thus the work per day is about 1,550,000 foot-pounds or 700 foot-tons. The shifts are measured by means of a simple sundial, improvised on the spot. Its essential part is a cord stretched horizontally north and south between the tops of two pegs a few inches above the ground, with marks to indicate the endings of the shifts by the progress of the shadow. The intervals between shifts are devoted to light occupation, meals, and rests.

From other well-known physiological data we may reckon that the gross efficiency of the work during the raising of water is about 20 per cent. As the work done is 1,550,000 foot-pounds, the corresponding amount of energy liberated in the body is therefore equivalent to about 7,750,000 foot-pounds, which is equivalent to almost exactly 10,000 British thermal units, or 2500 calories. This is at a rate of about 417 calories an hour, or 7 calories a minute. During the remaining 18 hours of the 24 the average energy liberated cannot well be less than 80 calories per hour, so that the total liberation of energy will be at least 4000 calories. To cover this expenditure the shadouf worker will, if we make the ordinary allowance of 10 per cent. for waste, require food of the energy-value of at least 4400 calories.

The men working on the shadoufs are erect and finely developed, looking a picture of health and physical grace, and doing the work without signs of fatigue. They take several meals daily between shifts. These meals consist usually of cakes made fresh each day from maize or wheaten flour, with cheese and sour milk. Hot meals, with lentils or

beans, and occasional meat, are taken at home. The work could not be kept up day after day if the food were not abundant. We were told that this food is almost entirely the produce of the land the men are irrigating and cultivating. The actual men who work the shadoufs and do the other work on the land are joint farmers. They thus work jointly for themselves and pay the rent jointly, taking all the produce and profits from its sale after the rent has been paid. The rents seem enormous by British or American standards, but the land, as actually worked, is extremely productive. It is very improbable that if the men were working on daily or weekly wages they would work so effectively or obtain the same net earnings. It seems also to be for essentially the same reasons that modern power-driven appliances have not displaced the shadouf. A shadouf is not only extremely efficient mechanically, but can be made from materials on the spot, and can be at any time repaired by the men who use it. To judge from carvings on a tomb near Luxor, the shadouf was practically the same more than three thousand years ago as it is now.

The work done on a shadouf is of special physiological interest, because it is so well standardised, employs so many muscles, and is so easily measured directly. In most kinds of standardised work we can only measure the work indirectly from the oxygen-consumption. In the late Mr. Jervis Smith's book on "Dynamometers" (edited by Prof. Boys) a description is given, on page 10, of another easily measured form of standardised human muscular work. This form of work was employed early last century in raising the earth needed in the construction of forts round Paris. The earth was loaded into a bucket attached to a rope passing over a pulley, and was then drawn up by the action of a counterpoise consisting of a man, whose work consisted in continuously ascending a ladder and coming down as a counterpoise to the ascending earth. It was found that the work done in this way amounted to 4230 foot-pounds per hour—a figure very close to ours for the shadouf worker as regards the rate per hour, though the French navvies kept up this rate during eight hours daily.

There can be no doubt that where the motive is adequate a man in good physical training, and fed in correspondence with the work, can keep up day after day, for say eight hours, a considerably greater rate of measured work than corresponds to these figures; and for short periods far greater rates are possible. Thus Henderson and Haggard (*Amer. Journ. of Physiology*, **72**, p. 264, 1925) found that over a four-mile race in 22 minutes each oarsman of a university crew did average measured work at a rate of 0·45 horse-power, or 15,000 foot-pounds a minute, with a total energy-expenditure of 19 calories a minute, or at the rate of 1140 calories per hour. This rate is $3\frac{1}{2}$ times that of the shadouf workers, but, of course, could not be kept up nearly so long. In a $1\frac{1}{4}$ mile rowing race the rate rose to 0·57 horse-power, or 18,770 foot-pounds a minute. For very short periods of less than a minute, still higher rates are possible, even for an untrained man. For example, Douglas and Haldane, with the view of producing maximum discharges of lactic acid from muscles during their temporary lack of oxygen, used short bursts of climbing work at a rate of 30,000 foot-pounds per minute (*Journ. of Physiology*, **38**, p. 431, 1909). The rates of work of the shadouf men and of the French navvies are, however, worthy of record, as these rates could, without unusual effort, be maintained day after day throughout the working period.

We have pleasure in acknowledging the help we received from Mr. George Gattas, of Luxor, a chief dragoman on Messrs. Cook's Nile Service steamers.

Audibility of Explosions and the Constitution of the Upper Atmosphere.

By F. J. W. WHIPPLE.

PHYSICISTS who are interested in the problem of the temperature and constitution of the upper atmosphere have been awaiting with some impatience the publication of the official reports on the audibility of the experimental explosions arranged by the International Commission for Investigations on the Sound of Explosions. The first experiment was made (at Oldebroek in Holland) in October 1922, but the full report on the second experiment or series of experiments has appeared first. This report[1] has been prepared by Prof. Charles Maurain, head of the Institut de Physique du Globe at Paris. Some idea of the mass of evidence that has been digested may be gathered from the facts that 405 observations were plotted on the map showing the audibility of the first explosion, 360 and 240 on the maps for the second and third.

The site of the explosions was at La Courtine; this place is about half-way between Paris and the Pyrenees; as it is more than 250 km. from the nearest sea, the audibility in all directions could be investigated. There were four explosions, on May 15, 23, 25, and 26, 1924. In each of the first two, about ten tons of melanite was spent, in each of the others, five tons. Observers did not receive sufficient warning in the last case, and M. Maurain's report is practically confined to the other three.

The great advantage of organisation is manifest throughout the report. When explosions have occurred by accident, the places at which they were heard have in many cases been mapped successfully, but accurate records of the time have been rare. With an experimental explosion the observers are ready to note the time to a second at which the sound reaches them. In many of the places from which Prof. Maurain received reports, the agreement between the observers was excellent. Perhaps the best example of precision is provided by the observations at Bordeaux on the first occasion. In the observatory and near by, four observers gave the time as 19 h. 44 m. 5 s., two gave 19 h. 44 m. 4 s., and one 19 h. 44 m. 3 s.

Another advantage is that full information can be obtained as to the meteorological conditions. There were at least two soundings of the upper air in France on each of the three 'La Courtine' days, and the stratosphere was reached on each occasion. Special

[1] Annales de l'Institut de Physique du Globe. Fascicule spécial consacré aux expériences de La Courtine sur la Propagation des ondes aériennes. Paris, 1926.

pilot balloon ascents gave the direction of the air currents in the lowest three or four kilometres.

In the discussion of the observations, Maurain distinguishes between normal and abnormal audibility; for normal audibility the quotient of distance and time is approximately equal to the velocity of sound near the ground, whereas for abnormal audibility the quotient is considerably smaller. In each of the three La Courtine experiments there was a well-defined zone of silence separating zones of normal and abnormal audibility. The maps illustrating the last two experiments are comparatively simple and remarkably consistent. In each, the zone of normal audibility extends about 100 km. N.E. from La Courtine (with the wind), but barely 25 km. in the opposite direction. The zone of abnormal audibility occupies a quadrant to S.W., the minimum distance being about 160 km.

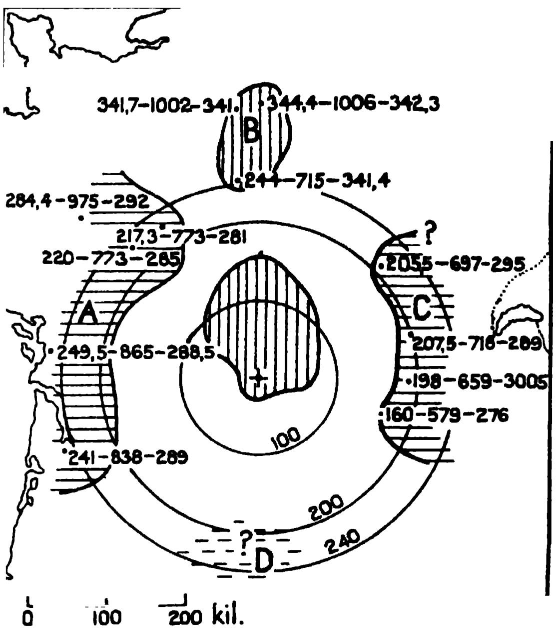


FIG. 1.—The numbers against the dots representing reporting stations are:—The distance from La Courtine in kilometres, the time after the explosion in seconds, and the quotient in metres per second. The circles are not in the original.

Two or three small detached areas of audibility are also shown to the east and north. The map for May 15, which we reproduce (Fig. 1), is of special interest on account of its remarkable symmetry. There were zones of abnormal audibility to east and west of the explosion. A detached region of normal audibility is also mapped in the neighbourhood of Paris, but it is to be noted that the observations in this area were instrumental. The records suggest waves of long period, beyond the range of the ear. With the favouring wind, the long waves travelled better than short ones through the lower atmosphere. As evidence for the favouring wind, it may be mentioned that the Upper Air Supplement of the Daily Weather Report shows that there was a current from the south crossing the English Channel at the cirrus level; the velocity deduced from nephoscope observations was about 100 miles per hour.

In a report of this kind the presentation of the observations in a convenient way is the main issue; it is to be regretted, however, that in the theoretical discussion the author has ignored details and adopted very rough approximations. Although he has been at pains to record the distribution of wind and temperature in the lower atmosphere, he boldly assumes that the sound rays in that region are straight. Moreover, he assumes that the stratosphere is uniform in temperature and composition up to 50 km. above ground, and does not test alternatives. His conclusions are that the high temperature postulated by Lindemann and Dobson for the atmosphere at 60 km. and above (say 300° A.) is not high enough to account for the recurving of the sound rays, and that Von dem Borne's hypothesis of the hydrogen atmosphere must be invoked. He goes so far as to hazard the estimate of 92 per cent. of hydrogen in the constitution of the atmosphere at 116 km., the height suggested for the apex of the path of the sounds heard at Bordeaux.

Fortunately, the observations provide us with a simple criterion by which such statements can be tested. Prof. Wiechert has reminded us recently that there is a close relation between the rate at which the intersection of a sound wave with the earth progresses and the velocity of sound at the apex of the trajectory. In the case of absence of wind and uniform stratification, these are equal. If there is a wind at the level of the apex, the component of the wind velocity in the direction of propagation of the sound must be allowed for. Now, in the La Courtine experiments there are three cases in which the radial velocity of the disturbance in the zone of abnormal audibility can be estimated.

In the first experiment there were well-supported observations to the north-west of La Courtine, at Chinon, and at Angers.

	Distance from La Courtine = X.	Time after explosion = T.	ΔX.	ΔT	ΔX/ΔT
Chinon . .	220 km	773 sec	.	..	.
Angers . .	284 4	975	64 4	202	0 319.

On May 23 there were observations at Angoulême, Rochefort, and Bordeaux, and as the straight line from La Courtine to Angoulême when produced bisects approximately the line from Rochefort to Bordeaux, we may take the average of the co-ordinates of those two stations for comparison.

	X.	T.	ΔX.	ΔT.	ΔX/ΔT.
Angoulême . .	162 km.	614 sec	..	..	..
Bordeaux and Rochefort	244	845	82	231	0 355.

On May 25 there were observations at Vélines between La Courtine and Bordeaux.

	X.	T.	ΔX.	ΔT.	ΔX/ΔT.
Vélines	191 km.	690 sec.	..	..	..
Bordeaux . . .	241	843	50	153	0·327.

It will be seen that in each of these cases the sound travelled across the zone of abnormal audibility with a speed differing but little from the ordinary speed of propagation, which for the temperature 17° C. is about 341 metres per second. In each case the sound was travelling against a light surface wind and would be retarded thereby.

Two deductions may be made:

(1) In the outer part of the zone of abnormal audibility the wave fronts were nearly vertical, the rays nearly horizontal.

(2) Unless the apexes of the sound rays were in a region of strong wind, they must have been at a level where the velocity of sound was about the same as at ground level.

Prof. Maurain's hypotheses are at variance with these deductions from the observations. He contemplates rays, the inclination of which at the ground is only 22° from the vertical, and the velocity of sound at the apex of such sound rays is said to be 786 metres per second. It is clear that further discussion of the observations is called for.

In our diagnosis of the conditions, we start with the known facts with regard to the state of the atmosphere on May 15. As a good approximation we take the temperature of the surface air as 290° A., the lapse rate of temperature $6\frac{2}{3}°$ per km. up to 12 km., and assume a uniform temperature 210° from 12 km. upwards.

The region of uniform temperature may be supposed to extend to a height H_2. Above H_2, temperature is higher. It may be supposed that at the height H_3, temperature is the same as on the ground, 290° A., the inverted lapse rate being the same from H_2 to H_3 and beyond. With these assumptions, wind being ignored, a sound ray consists of arcs of cycloids in the troposphere and the upper atmosphere and of straight lines in the stratosphere.

For a ray starting with a given inclination to the horizon, the range, etc., can be expressed as linear functions of H_2 and H_3. For example, for a ray starting with the inclination $\psi = 15°$, we have the formulæ:

Range in kilometres $= X = 17{\cdot}8 - 5{\cdot}46H_2 + 8{\cdot}35H_3$
Time of passage in seconds $= T = 30{\cdot}54 - 14{\cdot}55H_2 + 26{\cdot}64H_3$.
Height of apex in kilometres $= Z = 1{\cdot}26H_3 - 0{\cdot}26H_2$.

The observations of audibility give values of X and T and, if the inclination of the sound ray is assumed, such formulæ can be used to determine H_2 and H_3.

Four examples are quoted in the following table:

	X.	T.	ψ.	H_2	H_3	Z.	θ	V.
1.	220	773	15	32	45	48·6	311	0·354.
2.	220	773	5	33	44	44·1	292	0·343.
3.	284	975	0	34	51·5	51·5	290	0·341.
4	160	579	20	30	37	40·7	328	0·363.

ψ = initial inclination of ray, θ = temperature at height Z; V = corresponding velocity km./sec.

In the first two, the values of X and T are those appropriate for Chinon on May 15; the alternative values 15° and 5° are assumed for the inclination.

In the third example, the figures for Angers are used, this being a case of a very long range, and in the fourth example, the figures for Unieux are selected to illustrate a very short range.

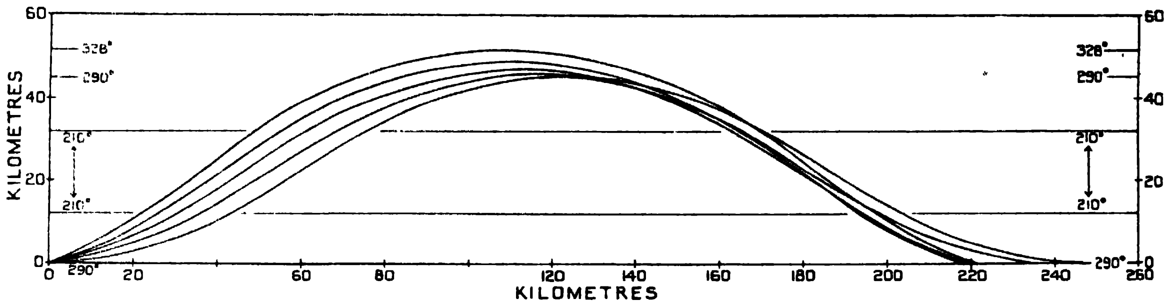
It will be seen that in each of these cases it is indicated that the region of high temperature begins at about 30 km. above ground. The apex of the specified ray is between 40 and 50 km. above ground, and the temperature there is in the neighbourhood of 300° A.

Values of H_2 and H_3 having been determined, we can compute the values of X and T for rays of various inclinations. Thus, if H_2 is 32 and H_3 is 45·2, we obtain the following table:[2]

ψ_0.	X.	T.	ΔX.	ΔT.	$\Delta X/\Delta T$
0	247·5	853·7	..	.	..
5	234·4	815·4	13·1	38·3	0·342.
10	225·3	789·0	9·1	26·4	0·345.
15	220·3	774·8	5·0	14·2	0·352.
20	219·8	773·3	·5	1·5	..
25	224·3	785·6	−4·5	−12·3	0·370.

It will be seen that the range is a minimum for an inclination about 18°. The figures in the last column illustrate Wiechert's principle.

The course of the rays in this example is illustrated in Fig. 2. The figure shows how the rays which return to earth are distributed over a rather narrow zone. That the zone of abnormal audibility is actually wider in observed cases is no doubt to be explained by the complication introduced by wind. The computation of the exact forms of rays with the influences of wind and temperature both taken into account is very cumbersome. To discover a hypothetical distribution of both elements consistent with all the reported observations would therefore require much laborious arithmetic. It is to be hoped that some one will carry this through. It is not likely, however, that the general result, that the observations imply a region of high velocity and high temperature between 30 and 50 km. above ground, will be modified. That this was probably the interpretation of the La Courtine observations was noticed when the preliminary account was published (F. J. W. Whipple, *Meteorological Magazine*, 1925, p. 16). Wiechert has come to the same conclusion as the result of the study of all the available evidence with regard to abnormal audibility (*Met. Zeitschrift*, March 1926, p. 90).



The existence of high temperatures at great heights was deduced by Lindemann and Dobson from the evidence provided by observations of meteors (*Royal Soc. Proc.* A, vol. 102, 1922, pp. 411-437). That this hypothesis would explain the 'abnormal' audibility of explosions was seen at once. There is, however, an apparent discrepancy. Lindemann and Dobson considered that the stratosphere with its uniform temperature might be regarded as reaching nearly to

[2] The figures quoted for 15° elevation do not tally precisely with the formulæ for X and T in which the coefficients have been rounded.

60 km., and credited the higher temperature to the region above that level. The discussion of audibility brings the transition down to 30 km. It seems, however, that the meteor observations are not inconsistent with this modification of the hypothesis.

In Fig. 3A, which is reproduced from part of Fig. 3 of Lindemann and Dobson's paper, the density of the air at different levels is shown by crosses and dots. Each cross shows the density computed for the point of appearance of a meteor, each dot that for a point of disappearance. The curve shows the density calculated on the assumption of a uniform temperature 220° at all levels above 12 km. The curve runs from 220° to 300° occurs between 30 km. and 40 km. The fit is now a little better. Finally, in Fig. 3D, I have made the rise of temperature begin at 30 km. and assumed a regular increase up to 50 km. At that level and beyond, the temperature is 380°. The assumptions are now in reasonable agreement with the observations.

It is difficult to believe that the atmosphere at 60 km. is really at a temperature above the normal boiling-point of water. That seems, however, to be the logical conclusion from the theory of Lindemann and Dobson. For our present purpose the essential point is that the meteor observations do not

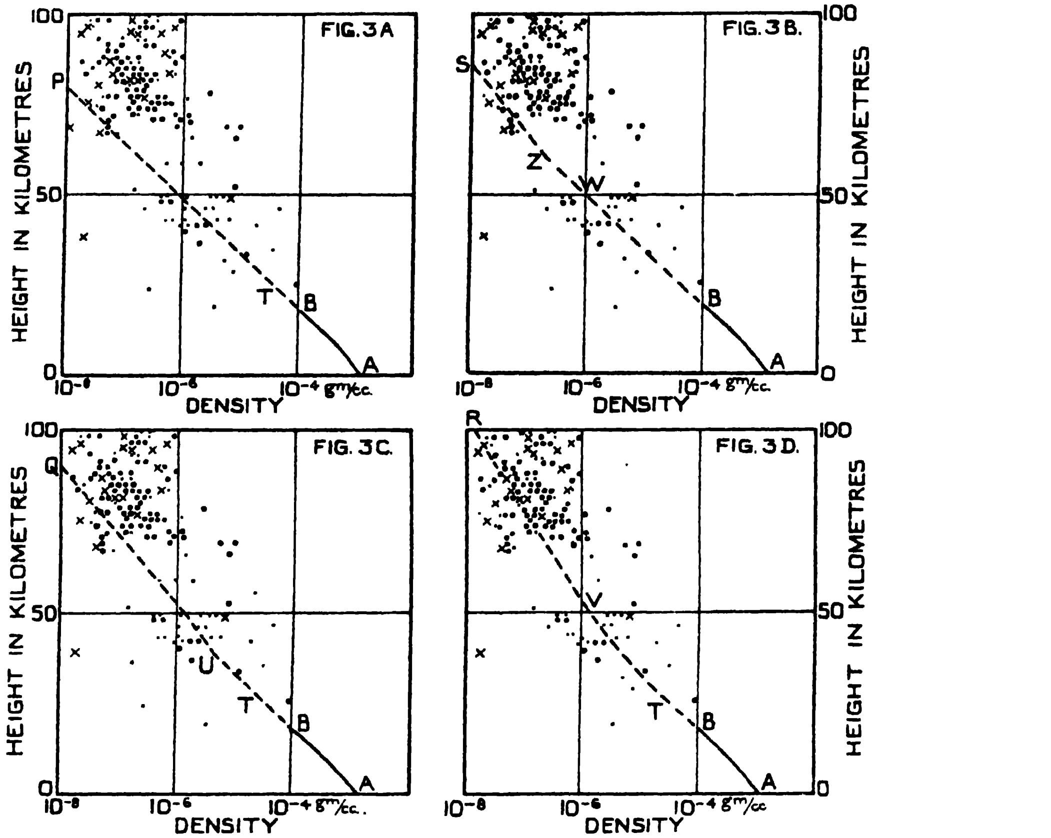


FIG. 3.

fairly through the points representing meteor observations below 60 km. As Lindemann and Dobson point out, above 60 km. the meteor observations "all indicate densities very much greater than those calculated on the assumption of a uniform air temperature of 220° A., but consistent with a considerably higher temperature." They state that the rate of change of density with height shows that the temperature is probably about 300° A., but how this estimate is reached is not clear. I have shown in Fig. 3B the curve which represents the relation between density and height on the assumption that temperature is 220° from 12 km. to 50 km., that there is a uniform gradient to 60 km., and that temperature above 60 km. is 300°. It will be seen that the curve does not represent the meteor observations at all well. In Fig. 3C I have adopted the hypothesis that the transition conflict with the hypothesis suggested by the phenomenon of abnormal audibility, *i.e.* that temperature is about 220° up to 30 km., about 300° at 40 km., and possibly higher above that level.

The apparent inconsistency between the theory of Lindemann and Dobson and their conclusions was pointed out recently by C. M. Sparrow, who interprets their diagram as implying a temperature of 480° (*Astrophysical Journal*, 63, March 1926, pp. 90-110). Sparrow does not accept the theory, and puts forward one of his own, which does not require high temperatures at all. The reply of Lindemann and Dobson to Sparrow's arguments has not yet appeared.

Realisation of the probability that the transition from the uniform temperatures of the stratosphere to much higher temperatures begins at the comparatively modest height of 30 km. makes it desirable to extend

the range of soundings by free balloons to that height, and beyond. By the proper choice of balloons that should be possible.

Another line of attack is also open. We are familiar with the fact that, during the War, gunfire was heard regularly at distances exceeding 100 miles. Why should not similar observations be made systematically in peace time? I should like to inquire whether gun practice at Portland is heard in South Wales. If there is any quiet spot in that region where the sounds are heard frequently, observations should be timed and, with a little organisation, valuable information would be obtained. The advantage of frequent observations of this kind as compared with the occasional 'big bang' is obvious.

Since this article was written I have had an opportunity of testing the possibility of timing the passage of the sound of gunfire. Listening at Grantham on June 28 for the discharge of guns at Shoeburyness, 115 miles away, I found that the time of passage increased gradually from 10¾ to 11½ minutes and then began to decrease. Details have been published in the *Meteorological Magazine* for August.

Obituary.

Dr. J. F. Hall-Edwards.

We regret to record the death on August 15, at the age of sixty-seven years, after many years of suffering due to extensive X-ray injuries, of Dr. J. F. Hall-Edwards. He was educated at King Edward's School and at Queen's College, Birmingham, and after qualifying in medicine he went into practice. Soon after the discovery of X-rays, Dr. Hall-Edwards took up their application in medical work and was one of the earliest authors in radiography. He served in the South African War as surgical expert in X-ray work to the Imperial Yeomanry Hospitals at Deelfontein and Pretoria, receiving the Queen's medal with four clasps. In spite of disabilities which might well have deterred him from any further executive work, he applied for and received a commission as temporary Major in the R.A M.C. at the outbreak of war in 1914, and served in a radiological capacity to such effect that official recognition of his services was made on two occasions. He was an honorary member of the Röntgen Society and the author of several original papers in the journals of this Society and of the Electro-therapeutic Section of the Royal Society of Medicine.

Dr. Hall-Edwards made a great fight for many years against the insidious damage which he had suffered when using X-rays in his medical work. Like other pioneers he suffered because protective methods were unknown. His services in the public cause which so unhappily affected him, were recognised by the award of a Civil List pension in 1908, and later, in 1922, he received the Carnegie Hero Trust Medallion with an annuity.

S. Russ.

We regret to announce the following deaths:—

Dr. Charles W. Eliot, for forty years president, and since 1909, president emeritus of Harvard University, who was largely responsible for raising Harvard to its present high position among the universities of the world, on August 22, aged ninety-two years.

Dr. D. E. Flinn, formerly medical inspector of the Local Government Board, Ireland, editor of the *Health Record* and author of works on public health and hygiene in Ireland on August 18, aged seventy-six years.

News and Views.

Sir Arthur Evans's paper on "The Shaft Graves of Mycenæ and their Contents in Relation to the Beehive Tombs," which was read before the Anthropological Section of the British Association at Oxford, was something in the nature of a bomb-shell, of which the effects will be far-reaching. The relation of the great beehive tombs at Mycenæ, which were found empty of their sepulchral contents, to the shaft-graves, so rich in sepulchral relics, found by Schlieman within an extension of the Acropolis wall, has always been a puzzle to archæologists. Sir Arthur's paper revived a theory, first put forward by Prof. Gardner and arrived at independently by himself, that at a time of danger the royal burials had been transferred from the mausolea outside the walls to a site which could be included within the enceinte. This theory has not found favour among archæologists, and the view generally held is that the two classes of tombs correspond to earlier and later dynasties at Mycenæ. Mr. Wace recently has carried the matter further and suggested that the two finest shaft-graves, the "Treasury of Atreus" and the "Tomb of Clytemnestra," belong to the latest groups, making them contemporary with a time when the Palace of Knossos was in ruins and the civilisation of Crete on the downward path. Sir Arthur Evans's latest discoveries render this theory untenable. He has found decorative sculptures, not later in date than the end of the Third Middle Minoan period and in vogue about 1700 B.C., which run parallel with those of the façade of the "Atreus" tomb. Vases characteristic of the same epoch were found in the "Tomb of Clytemnestra." He was able to demonstrate archæologically that the finest of the beehive tombs belong to the same date as the earliest elements in the shaft graves, and that both are equally Minoan. On this view their culture, with the exception of certain intrusive barbaric elements, can no longer be regarded as a 'mainland' culture and, as Sir Arthur pointed out, the term 'Helladic' as applied to it becomes a misnomer.

Sir Frederick Keeble, Sherardian professor of botany in the University of Oxford, has accepted an

appointment with the Synthetic Ammonia and Nitrate Co., which is associated with Messrs. Brunner, Mond and Co., for the promotion of research in the application of synthetic nitrogen compounds to agricultural purposes. He will probably be released from his chair at Oxford at the end of next term, and start upon his new duties in January. This appointment marks a further step in the movement towards a closer association of fundamental scientific research with commercial enterprises in connexion with agriculture. The growing use of artificial fertilisers renders it imperative that possible fresh sources of supply should be investigated and the value of the products thoroughly tested. As a measure of economy and as a means of protecting agriculturists from loss that might be incurred by using new and comparatively untried fertilisers, research with regard to their economic application is essential, and it is this that Sir Frederick Keeble will endeavour to foster. His wide and varied experience has already brought him into contact with certain aspects of the problem, for on the practical side he has served as controller of horticulture to the Food Production Department of the Board of Agriculture, as assistant secretary to the Board of Agriculture, and as director of the Royal Horticultural Society's Gardens at Wisley, and on the scientific side as professor of botany at Reading and at Oxford. The possibilities in connexion with the use of synthetic nitrogen compounds as fertilisers are of great importance to agriculture, as was pointed out by Sir Daniel Hall in his presidential address at Oxford to Section M (Agriculture) of the British Association, which appears elsewhere in this issue, and the development of this line of work will be followed with much interest.

FURTHER records of the British earthquake of August 15 show that the disturbed area is much larger than was at first supposed, for it was felt at King's Lynn, Gainsborough and Harrogate, so that the total area shaken may amount to 60,000 square miles. This is a high estimate, but it must be remembered that the shock was felt chiefly in upstair rooms and at a time when there were few disturbances to hinder its observation. The position of the epicentre is still uncertain, but it is probably nearer Ludlow than Hereford. That the depth of the focus was considerable is clear from the slow decrease outwards in the strength of the shock in the central district, and from the large area shaken. The shock seems to have been registered at most British stations. The interesting record obtained at Kew is reproduced in the *Daily Express* for August 17. At Stonyhurst, according to the Rev. J. P. Rowland, S.J. (*Times* for August 20), the first preliminary tremors began at 3h. 58m. 46s. A.M. (G.M.T.), and the second at 3h. 59m. 5s., implying that the origin was 103 miles from the observatory or close to Ludlow. "The chief element of uncertainty," he adds, "lies in the determination of the time of commencement of the preliminary tremors, which are very small and difficult to read."

WHAT was probably the first important geological discovery from the air was made in 1920 by Dr. P. Chalmers Mitchell in the course of *The Times* African aeroplane flight. Between Khartum and Wady Halfa the Nile follows an S-shaped course. Flying over the unexplored country within the southern loop of the S, Dr. Mitchell observed a great plain of lava diversified with a number of craters and resembling, as he said, "an enlarged view of the moon." Part of this previously unvisited volcanic field has now been explored by motor car by Mr. H. C. Jackson (*The Times*, August 18). South-west of Sani Wells two conspicuous extinct volcanoes were found; one of the somma type, and the other, graphically called "the Place of Gloom," with an apparently complete crater "of awe-inspiring dimensions." Dr. Mitchell thinks that these craters lie to one side of those over which he passed, and states that Dr. Grabham, the Government geologist of the Sudan, hopes soon to make a survey of the area. Geologists will await with interest the petrological and tectonic description of the field, for its situation is in a line with the western branch of the Rift Valley system, though far to the north of any hitherto suspected continuation of that branch. It is clear from this example alone that many parts of the world may still hold surprises, even for geographical explorers.

THE president of the Board of Trade has appointed a standing committee to consider and advise on questions connected with the economic use of fuels and their conversion into various forms of energy, having regard to national and industrial requirements and in the light of technical developments. The members of the committee are: Sir Alfred Mond, M.P. (chairman), Mr. J. Baker, M.P., Mr. Mark Brand, Sir John Cadman, Sir Arthur Duckham, Sir William Hart, Mr. Frank Hodges, Prof. F. A. Lindemann, Sir David Llewellyn, Mr. M. Mannaberg, Mr. C. H. Merz, Sir Alexander Walker, and Mr. D. Milne Watson. The secretary of the committee is Mr. W. Palmer, and the assistant secretary Mr. R. J. Moffatt. All communications should be addressed to the secretary, National Fuel and Power Committee, Board of Trade, Great George Street, S.W.1.

PROF. ELLIOT SMITH, in the *Morning Post* for August 23, again raises the question of the origin of American culture, apropos of the articles by Dr. T. W. Gann on his discoveries on ancient Maya sites in Central America, which appeared in that journal in the early part of the year. Prof. Elliot Smith now offers the interesting suggestion that the remarkable stone causeways of the Maya found by Dr. Gann are distinctive of work of that period in Indo-China and Java, where there were definite reasons for their construction, and that they were introduced from those countries into Central America, where, however, the reasons for their construction no longer existing, they continued to be constructed from force of habit. He goes on to refer to the arguments recently advanced by Dr. C. Handy that the Maya temple and the Polynesian oracle-house were both copies of the Cambodian temple. A third class of evidence to

which Prof. Elliot Smith directs attention is connected with the cultivation of the sweet potato. The methods of cultivation employed are identical not only in New Zealand by the Maoris and in America, but also throughout Oceania, Cambodia, China, and Japan. Further, it is held that *Kumara*, the Maori word for the sweet potato, also occurs in Ecuador and Peru as *Kumar*, but in addition, F. W. Christian has recently suggested that the word itself is to be derived from the Sanskrit word for the white lotus.

MAJOR FRANCO and Capt. Ruiz de Alda have published a book "de Palos al Plata" giving an interesting record of their adventurous voyage in a seaplane across the South Atlantic from Palos in Spain to Buenos Ayres. They make it clear that an important factor in their success was due to the Marconi direction finder and the radio telegraphic apparatus they carried. On several occasions the direction finder prevented them from making unnecessary detours. There was a fog when approaching Las Palmas. They signalled the radio station there to send continuous signals so as to ensure a good descent. This was immediately done, the signals increasing in loudness until they were directly over Las Palmas, and a good descent was made. They experienced bad visibility again when approaching San Vincente, and again the direction finder proved to be of the greatest value. During their flight they were frequently in communication with passing ships, which sent them their bearings and sometimes sent radio messages announcing their progress to their next stopping place. The authors conclude that the direction finder enabled them to navigate with a maximum inaccuracy of about 3°. This is equivalent to efficient dead reckoning navigation and even to very fair astronomical navigation. They consider that radio telegraphy is indispensable for flights over the sea or sparsely populated countries.

RESULTS of meteorological observations made at the Radcliffe Observatory, Oxford, in the five years 1921–1925, prepared under the direction of Mr. H. Knox-Shaw, Radcliffe Observer, have recently been published by order of the Radcliffe Trustees. The work consists of five annual parts which deal with the observations for the several years. Commencing with 1925, changes in the routine of observation have been introduced; the numbers of eye-readings have been reduced from three to one each day, and the photographic barograph and thermographs which have been in use since 1881 have been superseded. Various other alterations of smaller detail have been introduced, but they are clearly stated. Now that observations have been recorded for seventy-five years or thereabouts, the mean results of barometer, temperature, and rain are as accurate as they will ever be. The mean of the maximum or day temperatures is 70°·8 F. in July, which is the warmest month of the year, and the mean of the day readings in January, the coldest month of the year, is 43°·7 F. The mean of the minimum or night readings for the corresponding months are respectively 53°·3 F. and 34°·5 F. The rainfall for seventy-five years gives the annual average 25·99 in. The wettest month is October, with an average fall of 2·84 in., and the second wettest month is July, with 2·58 in. The driest month is February, with 1·65 in., and the next driest March, with 1·73 in.; but making allowance for the different lengths of the two months, less rain falls on a March day when the average daily fall is 0·056 in., while in February it is 0·058 in. The sunshine records cover forty-five years; the sunniest months are May and June, each with average sunshine for 194·5 hours; the least sunny month is December, with the average sunshine 43·8 hours.

ACCORDING to a despatch of the Cairo correspondent of the *Times*, which appears in the issue of August 16, Mr. Alan Rowe, field director of the Palestine Expedition of the University Museum, Philadelphia, has succeeded in identifying the two temples of the Philistines mentioned in the First Book of Chronicles, x. 10. Of the four temples at Beisan (Beth-shan) built during the Egyptian occupation, two belong to the reign of Rameses II., and of these the southern is identified with the 'Temple of Dagon,' which was dedicated to the warrior god Resheph; the northern, which was dedicated to the warrior goddess Antit-Ashtoreth, was the 'House of Ashtoreth.' It is conjectured that a sanctuary was established in one or other of these temples by David after he had destroyed and partially reconstructed them. A consideration of the results of the season of 1925, and the examination of the archæological objects then obtained, has afforded material for suggestion as to the relation subsisting between Crete, Anatolia, and Philistia before the driving out of the Philistines by King David. The Egyptian mercenary troops who occupied Beth-shan appear to have included an Ægean-Anatolian element before the coming of the Philistines. The walls of the temples of Seti I. and Rameses II. apparently were built by the mercenaries themselves. Some bricks bear signs identical with certain Minoan signs, and not only are the cylindrical cult objects and ring flower-stands Minoan, but also they do not appear on the site before the time of Seti I. The presence of Cretans among the mercenaries had not previously been recognised.

IN the July issue of the *Quarterly Review* Mr. Robert Steele has an illuminating article on the early days of chemistry. He points out that in the Dark Ages of Europe there were two great civilisations, still at the height of their powers, with a foothold in Europe, namely, the Byzantine and the Arab. Byzantium was, however, cut off from Atlantic Europe, whereas the Arab civilisation seems from the first moment of reviving curiosity as to science to have been that to which all eyes turned, in spite of the difference of religion and language. By the middle of the twelfth century a learned world had come into being in Europe, but this renaissance was literary: it knew nothing of science. A century later, however, science

was beginning to come into its own, through the efforts of such translators as Adelard of Bath, Gerard of Cremona, Robert of Chester, and Plato of Tivoli. Among the other Greek sciences which thus came to Latin Christianity by way of the East was alchemy, which had been studied widely and enthusiastically by the Muslims. Mr. Steele's sketch of alchemy in Islam is brief but clear, and by basing it upon recent investigations into this subject he has avoided the errors and misconceptions which are commonly met with. His unrivalled knowledge of medieval Latin alchemy has enabled him to present the salient features of an interesting period in a way which the general reader will find easy to follow and the specialist extremely suggestive.

MR. THOMAS SHEPPARD, director of the Hull Museum, has issued (*Hull Museum Publications*, No. 87) a catalogue of the various exhibits relating to shipping and fisheries which are permanently housed in a special building presented by the late Mr. C. Pickering and situated in Pickering Park, Hull. At one time the whaling trade at Hull was of immense importance, and from it has sprung the present fish and oil trades of that port, which have now grown to an enormous size. It is, therefore, a fitting centre for an exhibit of this kind, and much trouble has been taken to bring together all relics of the old whaling industry which was connected with Hull so early as 1598. The collections are of remarkable interest, embracing as they do an historical series of whaling implements and many valuable old prints and paintings representing the gradual growth of the shipping and fisheries industries. There are many other things in the museum, which is by no means confined to whaling, but all are connected with shipping, fisheries, or exploration in some way, and there is a nucleus of a good library on these subjects. We note that the Adélie penguin (No. 174), brought by the *Terra Nova* from Capt. Scott's last Expedition, is unfortunately described as coming from the Arctic, instead of the Antarctic. Mr. Sheppard is to be congratulated on the catalogue, which adds very much to the value of this interesting little museum.

THE Board of Education has issued a "Report on the Science Museum for the Year 1925." Our copy is marked "For Official Use"; at the same time it is said to be published by H.M. Stationery Office at 1*s*. net. The restriction of the report to 24 pages does not permit elaborate treatment, but enough is said to show that many objects of considerable interest were placed on exhibition during the year. The more important among them were mentioned in NATURE at the time. The value of this museum may be inferred from three classes of visitors. School children come in large numbers, both on their own account and under the guidance of their own teachers. Students make much use of the collections. Officers and technical experts have found here alone the evidence that enabled judgment to be passed on various claims arising out of the War. The space allotted to the exhibition galleries is therefore fully justified. At the close of 1925 it amounted to 155,000 square feet, and the addition of galleries giving 22,000 square feet was authorised by the Government. Even this, however, will not suffice, and of it 45,000 square feet is in old buildings not considered sufficiently fire-proof. "The construction of the centre block, to provide about 100,000 square feet, is therefore an urgent need." The War, while retarding the building operations, gave a great impetus to invention, and thus, on both counts, enhanced the congestion. The Science Museum, it should be remembered, is only one of a number of rapidly expanding institutions in a limited area.

IT is stated in *Science* that the gold medal of the American Geographical Society has been awarded to Dr. Erich von Drygalski, professor of geography in the University of Munich and leader of the German South Polar Expedition of 1900 to 1903.

THE following have been elected officers of the Röntgen Society for the session 1926–1927: *President*, Mr. N. S. Finzi; *Vice-Presidents*, Dr. Robert Knox, Prof. A. W. Porter, Prof. S. Russ; *Hon. Treasurer*, Mr. Geoffrey Pearce; *Hon. Editor*, Dr. G. W. C. Kaye; *Hon. Secretaries*, Mr. Russell J. Reynolds, Prof. F. L. Hopwood.

A QUANTITY of palæolithic implements, stated in the *Times* of August 17 to number more than 200, has been obtained from a gravel pit, at a depth of 12 feet, on the City of Norwich sewage farm at Whitlingham. The discovery is due to Messrs. H. H. Halls and J. E. Sainty, who, in examining the material thrown from the pit by workmen, found two well-made examples of the hand-axe. Mr. J. Reid Moir has examined the deposits and the implements. He has pronounced them to be of Acheulean type, and considers that the gravels in which they were found were laid down just before the third glacial epoch. The implements exhibit a brownish-yellow patination and some exceed 1 ft. in length.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant bacteriologist in the department of pathology and bacteriology of the University of Sheffield—The Registrar (September 11). A lecturer in mathematics at University College, Nottingham—The Registrar (September 14). A junior technical officer in the aerodynamics department of the Royal Aircraft Establishment—The Employment Department, R.A.E., Farnborough, Hants (September 18, quoting Reference A. 122). An engineer to take charge of the Wood Preservation Section of the Forest Products Research Laboratory of the Department of Scientific and Industrial Research—The Secretary of the Department, 16 Old Queen Street, S.W.1 (December 1). A teacher of biology at Gordon College, Khartoum—The Sudan Government London Office, Wellington House, Buckingham Gate, S.W.1. A part-time lecturer in mathematics at Birkbeck College—The Secretary, Birkbeck College, Breams Buildings, Fetter Lane, E.C.4.

Research Items.

MUSIC OF THE SAN BLAS INDIANS.—Advantage was taken of the opportunity afforded by the presence of Tule Indians of Panama in Washington in 1924, to investigate their physical characters and certain aspects of their culture. It will be remembered that the chief point of interest about these Indians, who were brought to the States by Mr. R. O. Marsh, centred in the question whether there was among them a truly 'white' element, as Mr. Marsh claimed. Observations on their music were made by Frances Densmore, and these are now published as No. 11, Vol. 77 of the *Smithsonian Miscellaneous Publications*. The "official musicians," with the chief and the doctors, are the most important people in the villages. Of these the chief may act as a doctor, but not the musician. There are four musicians, two "Chief" and two "Assistant Musicians," in each village who know the songs and teach them for pay. Social gatherings, weddings, etc., are attended by one chief and one assistant musician, never more, for the entertainment of the people. In addition to the songs sung for entertainment there are songs with a definite purpose, such as the treatment of the sick, and songs sung as "charms" which are sold by the doctors. The principal instruments are the flute and the panpipes. The man from whom the songs in the present record were obtained was an amateur who had learnt his songs, some thirty in all, from the official musician. The first song he had learnt was that which brought success in catching a turtle. He also learnt the medicine man's songs, though not himself a medicine man. These include songs to make medicinal herbs effective, to cure headache and other ailments, and the songs that were sung after a man's death. The vocal and instrumental music of the Tule Indians is a form not hitherto recorded. It appears that though the substance of the words and the general character of a song is learnt, each performance is an improvisation. The tone is artificial and extremely difficult to acquire. It is very hard, with a pinched forced quality. The principal occasions for singing were the treatment of the sick, the scene after a burial, the maturity of a young girl and her wedding.

THE AUSTRALIANS AND SOUTH AMERICA.—In No. 18 of the *Compte rendu sommaire de la Société de Biogéographie*, Dr. Paul Rivet discusses the possible routes which might have been followed by the Australians in the migrations postulated to account for the Australian linguistic elements which he claims to have discovered in the language of the Ona of Tierra del Fuego. The sea route across the Pacific is out of the question in view of the scanty equipment of the Australian for navigation. No evidence can be brought forward to support the view that the Australians entered America from the north as did the immigrants from Asia. A third hypothesis was suggested by Mendez-Correa, namely, that they came by the south. The journey might have been performed by making use of the islands of Auckland, Campbell, Macquarie, Esmeralda, Wilkes Land, King Edward VII. Land, and Grahamland as stages. The powers of endurance of cold displayed by the Ona, which surpass those of the Eskimo, might be a result of a prolonged sojourn in these inhospitable regions. In present conditions, however, it is difficult to admit that the islands and shores of the Antarctic are habitable. It is, therefore, desirable to investigate whether there has been a change in climate in this area sufficiently recent for linguistic resemblances to survive, or whether there has been a glacial extension sufficiently marked to shorten the crossing by sea and on which the people could have found game for their subsistence. In discussion it was suggested that the zoological evidence pointed in the direction of this hypothesis and possibly to an extension of Tasmania to the Antarctic, while the geographical and bathymetric distribution of echinoderms suggested a more temperate climate and warmer water at one time in the Antarctic area.

EARLY DEVELOPMENT OF HUMAN EMBRYO.—In the latest volume of "Contributions to Embryology" (Vol. 17, 1926, *Carnegie Institution Publication*, No. 362) Profs. G. W. Bartelmez and H. M. Evans have published a detailed account of the development of the human embryo during the period of somite formation, including embryos with two to sixteen pairs of somites. The material dealt with comprises twenty-five embryos belonging mostly to the collections of the Department of Embryology of the Carnegie Institution and the Department of Anatomy at the University of Chicago. The memoir, which is illustrated by a fine series of plates, deals with many points of interest. It is shown that the cranial flexure is present from the beginning of somite formation, and is due primarily to the more rapid growth of the dorsal as compared with the ventral lamina of the mid-brain folds. The asymmetry, which in the case of the neural folds is a striking feature of the external form, is quite as marked in other systems. It is interpreted as due to localised differences in the rate of growth on each side. Differentiations in the ectoderm foreshadow certain regions of the head, and definite parts of these contribute to the formation of certain of the cranial ganglia in the 16-somite stage. The closure of the neural folds begins at the level of the fourth pair of somites in the 6- to 7-somite stage, and the neural crest is proliferated at about the same time. The origin and early development of many other structures are described in detail, and their phylogenetic and physiological significance are pointed out. Owing to the comparatively large amount of material available, the time-sequence in which the various parts appear has been traced far more fully than in any previous accounts of early human development.

NEUROGLIA CELLS.—Those who are interested in the study of neuroglia will welcome the paper by Dr. C. Da Fano in the current (June) issue of the *Journal of the Royal Microscopical Society*, in which the recent methods for demonstrating the neuroglia cells are carefully described. These methods were devised by Cajal and Del Río-Hortega, but Dr. Da Fano has given due weight in his account to his personal experience gained chiefly through a short stay in Del Río-Hortega's laboratory in Madrid. It is impossible to give a summary of the methods; the paper, which is illustrated by eight figures, should be consulted for the details of the several processes.

SOUTH AFRICAN MOLLUSCA.—Two papers on mollusca from South Africa appear in the *Annals of the Natal Museum*, vol. 5. Mr. J. R. le B. Tomlin contributes a paper on marine forms, including the description of eleven supposed new species, and one new genus belonging to the Tectibranchiata. This last, *Alexandria natalensis*, n. gen. et sp., the author places in the Acteonidæ on account of the shell apex, the radula and operculum. The paper is illustrated by one of Miss G. M. Woodward's excellent plates. H. C. Burnup supplies Part 2 of his memoir

"On some South African Gulellæ, with Descriptions of Some New Species and Varieties." The genus Gulella was formerly reckoned as a section of the genus Ennea, under which name most of the numerous species were formerly described. The fascinating little group, which externally calls to mind the British 'chrysalis shells,' is remarkable for the armature of the mouth, which in some is so studded with teeth that the occupants must be seriously incommoded when issuing or retreating. Twelve species are dealt with in this instalment, of which four are described as new, and the whole illustrated by the author on a plate of 39 figures.

COPEPODS IN THE BAY OF BISCAY.—In his account of the Copepoda from the collections made by Dr. G. H. Fowler on board H.M.S. *Research* in the Bay of Biscay in 1900, Mr. G. P. Farran (*Journal of the Linnean Society* (*Zoology*), vol. 36, April 1926) not only enumerates the various species but also gives most valuable data concerning their diurnal and nocturnal movements; thus treating the subject in a somewhat similar manner to that employed by Dr. Fowler himself for the Ostracoda in the same collections (1909). The samples were all taken in July, approximately in the centre of the Bay of Biscay, mainly along a diagonal line about 65 miles in length from the N.W. to the S.E. corner. The soundings taken lay between 1219 and 2341 fathoms, and the author divides his material into the epiplankton hauls made chiefly down to 100 fathoms with horizontal non-closing nets which lasted an hour or more, and the deep water hauls, almost all of which were made with closing nets hauled vertically. The former could not be treated quantitatively, but in the latter all the copepods were counted. The copepod population from the surface to 100 fathoms was found to be approximately doubled during the night by an upward migration consisting mainly of *Metridia lucens*, *Pleuromamma robusta* and *P. gracilis*, and from 50 fathoms downwards, *Undeuchaeta minor*, several other species joining in the migration. In the deep water hauls a number of little-known forms are noted whilst the new genus Bathyidia and fourteen new species are described, three of which belong to Calocalanus and five to Scolecithrix. The view that *Aegisthus dubius* is the male of *A. mucronatus* has been rejected by Sars, but the present author seems to have good cause to regard the question as still an open one

FISHERIES AROUND GREENLAND AND ICELAND.—The report of the North-western Area Committee (*Conseil Internat. Expl. Mer*) for the years 1924 and 1925 contains seven papers dealing with the hydrographical and biological researches undertaken in Greenland and Iceland waters. Hydrographical observations in the Faroe-Shetland Channel on May 3-14, 1924, showed that the water at the surface was composed of Atlantic water, while that at the bottom was bottom water from the Norwegian Sea. Between the two there was an intermediate layer formed by the mixing of Atlantic and bottom water with water introduced from the east Icelandic Arctic current. The biological part of the report deals with the five species of fish under the Committee's observation, namely, cod, halibut, herring, haddock, and plaice. It seems now beyond doubt that a particular stock or population of cod exists in Greenland which is indigenous to the waters of western Greenland. In Iceland, however, an almost unparalled density of young cod is experienced off the north and east coasts, in spite of the fact that very few cod-eggs are spawned there. Thus, the stock is recruited by drift, and the quantity must depend on the success of this drift. Faxe Bay, at the south-west part of Iceland, has proved to be a most important nursery-ground for the halibut, and there is little doubt that an enormous destruction of undersized halibut is caused by trawling operations in this area. The herring investigations are said to establish the fact that there are two distinct races of herrings in Icelandic waters, a spring herring and a summer herring, and that, as yet, no characters are known by which the Iceland spring herring can be distinguished from the Norwegian spring herring. Interesting figures from the estimations of age of haddock in Icelandic waters, in material collected over a number of years, show the way in which certain year-classes dominate. Thus, material of 1908–1909 showed an absolute dominance of the 1904 year-class, while that of 1924 indicated the predominance of the 1922 year-group. The study of the growth of haddock reveals the fact that growth is greatest off the south coast. Samples of plaice from Faxe Bay and Skiálfiandi Bay in Iceland were examined as to their age composition, and important conclusions were drawn from the analyses of catches at intraterritorial and extraterritorial trawling stations.

A NOVEL CURRENT METER.—In No. 2 of the *Journal du Conseil International pour l'Exploration de la Mer*, Mr. J. N. Carruthers describes a current measuring instrument which, lowered from an anchored raft or vessel, records the direction and velocity of the current. It is an advance upon the customary form of meter in that it may be left working for several days, when the velocity and direction of the residual current or drift of the water, over and above the tidal oscillations, can be found. The instrument has been put to fairly extensive use and has already provided very interesting information. It will undoubtedly prove of considerable value for purposes of fishery research in relatively shallow areas such as the North Sea and eastern end of the English Channel, where the drift of water carrying the egg and larval stages of fish plays an important rôle.

PROPORTIONS OF KRYPTON AND OF XENON IN THE ATMOSPHERE.—The values obtained in 1898 by Ramsay and Travers, shortly after the discovery of the above gases, and those obtained by Ramsay in 1903, differ greatly from one another. In the *Comptes rendus Acad. Sci.*, Paris, July 19, Messrs. C. Moureu and A. Lepape describe measurements made by the spectrophotometric method previously used by them. The two gases were fractionated from commercial argon by means of coconut charcoal cooled to suitable temperatures. The volumes obtained per unit volume of air were, kypton $1 \cdot 0 \times 10^{-6}$, xenon 9×10^{-8}.

SWEDISH RAINFALL.—The Swedish rainfall statistics for 1925 are already published in fairly considerable detail in Part 7 of *Årsbok* of the Swedish Meteorological and Hydrographical Institute. The greater part of a considerable volume is occupied with the data from 705 rainfall stations. In each case and for every month the figures given are the total, the heaviest fall in twenty-four hours, the number of days with precipitation of various stated amounts, and the days with hail and snow. The depth of the snow and its rainfall equivalent is added for certain stations. For the various departments of Sweden the duration of snow covering on the ground is given in another table. There are small scale rainfall maps for each month and a somewhat larger scale map for the year. The volume is very complete in the data it affords, but contains no discussion of the figures nor comparisons with the mean or any previous year.

CLIMATE OF NEW YORK STATE.—This subject is discussed by Mr. R. A. Mordoff in Bulletin 444 of the Cornell University Agricultural Experimental Station, Ithaca, New York. It is mentioned that the first organisation for local climatic observation in America was that inaugurated in 1825 by the New York Board of Regents. This was continued until 1863, when it was abandoned owing to the Civil War. In 1870 the National Weather Service was organised and five weather-observing stations were established in New York. Later, under the administration of the United States Weather Bureau, the number was increased to nine regular stations. It is said that New York State has a diversity of climate not usually encountered within an equally restricted area. Charts are given for each month showing the average temperature over the State. The temperature is greatly influenced by the proximity of the Lake Ontario and Lake Erie. Charts are also given showing the highest and the lowest temperatures recorded. During the summer months the maximum temperature often reaches 90° F. or above, and in winter temperatures of $-40°$ F. are experienced in exposed localities. Frosts are dealt with and the periods when killing frosts occur. Precipitation over the State is shown by monthly rainfall maps; the heavy summer rains are largely due to thunderstorms. There is a good distribution of rainfall throughout the growing season. A serious drought affecting the State as a whole is of rare occurrence; the two most serious in recent years occurred in 1889 and 1908. Winds, sunshine, and humidity are discussed. Analysing past records, it is asserted that no change of climate can be traced.

THE INHIBITION OF THE GLOW OF PHOSPHORUS.—It is now fairly certain that the propagation of the glow that accompanies the slow oxidation of phosphorus is a process comparable with the passage of flame through a combustible gas mixture. It is therefore possible to determine the rate of propagation by measuring the blast of gas necessary to maintain the glow in a fixed position. H. J. Emeléus describes the application of this method to experiments on the inhibition of the glow of phosphorus by ethylene, in the *Journal of the Chemical Society* for June 1926. Measurements of the effect of temperature on the action of the inhibiting substance at constant volume and constant pressure are included, and the mechanism of inhibition is discussed.

THE ATOMIC WEIGHT OF SILICON.—The apparent variation of the atomic weight of boron with the source of supply, and the discrepancies between the published values of the atomic weight of silicon, have led P. L. Robinson and H. C. Smith to redetermine the atomic weight of silicon in materials from different sources. In order to make the comparison it was decided to determine the densities of silicon tetrachloride with great accuracy. The tetrachloride was prepared by chlorinating ferrosilicon manufactured from silicon from different sources, and was carefully purified by fractionation, shaking with mercury, sodium amalgam, and finally fractional distillation in a vacuum. A full description of the density determinations is contained in the *Journal of the Chemical Society* for June 1926, the measurements involving the use of glass floats, calibrated in a standard liquid (bromobenzene) with properties similar to those of the tetrachloride. It appears from the results that there is no variation in the atomic weight greater than 0·005 of a unit. (See letter by authors in the present issue of NATURE, p. 303.)

ELEMENT 61.—Moseley's work on X-ray spectra showed definitely that an element with an atomic number 61 should exist between neodymium and samarium. Its isolation and X-ray analysis are the subjects of two papers by J. A. Harris and B. S. Hopkins, and by these two authors and L. F. Yntema, published in the *Journal of the American Chemical Society* for June 1926. When suitable rare earth minerals are fractionally crystallised using the double magnesium nitrates, element 61 concentrates between neodymium and samarium, but the ratio of the quantities of the new element and its neighbours is such that X-ray analysis fails to show its presence. Detection by absorption spectra, although more sensitive, fails on account of the width of the neodymium and samarium bands. If, however, the fractionation is carried out with the bromate series, element 61 concentrates with terbium and gadolinium, the former having one absorption band and the latter having none. By continued fractionation of this series the presence of a band was revealed which had always been regarded as due to neodymium. The crystallisation was continued until a fraction was obtained which contained sufficient of the new element for X-ray analysis. The *L*-series was investigated, and lines were obtained corresponding closely to the theoretical values for L_α and L_β of element 61. It is proposed to call the element illinium (Il), in honour of the state of Illinois and of the University (*v.* also NATURE, June 5, p. 792).

COSMICAL CREATION OF MATTER.—The issue No. 15 of the *Sitzungsberichte Acad. Sci.*, Vienna, for 1926 contains a suggestion by Dr. A. Haas as to the possibility of the creation of matter at any point of the universe at which, at a given instant, radiation is excessively concentrated. If at such a point an incandescent gas is present having a mean molecular speed of the order of one-half or one-third of that of light, about a hundredth of the molecules will have speeds equal to that of light, and energies equal to that of a proton and an electron. The observations of the Compton effect show that it is possible that a light quantum impinging on such a fast-moving molecule may have its frequency increased, and a repetition of the impacts may so raise the frequency of the quantum that its energy becomes equal to that of a proton and electron, and it is transformed into these two constituents of matter.

A MUMETAL MAGNETIC SHIELD.—A paper by Prof. A. V. Hill, describing an effective magnetic shield for a moving needle galvanometer, is published in the July number of the *Journal of Scientific Instruments*. The shield is constructed of 'mumetal' strip, wound alternately with copper strip on a copper cylinder. At each end it is closed by two mumetal plates separated by a copper plate. Although only two pounds of actual magnetic material is used in the device, a screening ratio of 1000 to 1 is obtained, which is a great advance on the screens in ordinary use. It seems highly probable, therefore, that moving needle galvanometers, after being neglected for some thirty years, will again come into favour. The sensitivity of these instruments is far higher than that of moving coil instruments, and the coils used can have a much lower resistance as they are not limited by the resistance of the suspension. Their only drawback is their liability to magnetic disturbance, and this has proved most troublesome in the past. It can now be almost wholly prevented by this shield made of a nickel-iron alloy. The editor of the *Journal* makes the useful suggestion that a shield could be employed as the case of a chronometer watch, and doubtless other uses can be found for it. It seems certain that cobalt steel permanent magnets and the use of nickel-iron shields will raise the sensitivity and greatly widen the sphere of usefulness of moving needle instruments.

The Recently Discovered Gibraltar Skull.

At the Oxford meeting of the British Association the first authoritative account of the discovery by Miss D. A. E. Garrod of a human skull associated with Mousterian implements at the Devil's Tower, Gibraltar, was given in a session of the Anthropological Section. The discovery was made on a site which first attracted the attention of the Abbé Breuil in 1917, who observed fragments of bone breccia in a cleft facing an old signal station known as the Devil's Tower. From this he obtained a few Mousterian implements and bones of a variety of animal species, including hyæna and panther, which are now extinct in Spain.

Miss Garrod, who undertook the excavation of the site at the suggestion of the Abbé Breuil, found that the cave contained a succession of seven deposits, which emerge from the mouth of the cave and spread fanwise in a succession of steps. All levels of the deposits contained a large number of animal bones, some broken and burnt by man, some evidently the relics of an animal's lair. As the cave faces north, it was probably occupied by man in summer only and by animals in the intervals of human occupation. The animal bones included deer, wild goat, boar, and rabbit in abundance, and, rarely, horse and ox. Resting on the raised beach which formed the seventh and lowest deposit was a carpal bone of an elephant. Implements of Mousterian type were found at all levels down to the fifth, those of the second level being definitely assignable to the upper Mousterian; but no implements of a later industry and no pottery were found.

The removal by dynamite of a large block of limestone in the hard travertine of the fourth level opened up a number of fissures and led to the discovery of a human frontal bone at a depth of 15 cm. from the surface of the deposit. The left parietal was discovered half a yard away, but, whereas the frontal bone had been loosened from its matrix, the parietal was firmly embedded in the travertine and had to be brought away in a mass of that material for reduction in the laboratory. As explained by Mr. L. H. Dudley Buxton, to whom that task was entrusted, the freeing of the interior from the mass of deposit with which it was filled proved a particularly difficult and tedious operation. Implements of quartzite and flint definitely of Mousterian type, but less well made than those of the overlying levels, were found near the skull. The fact that the skull and the implements were found embedded in the travertine in a manner allowing no possibility of disturbance places the Mousterian age of the skull beyond question.

The anatomical characters of the skull were described by Mr. L. H. Dudley Buxton. Owing to the fact that the greater part of the month which had elapsed since the skull had been brought to England had been taken up by the task of freeing the fragile bone from the travertine in which it had been embedded, it was possible to put forward tentative conclusions only; but an attempt had been made to reconstruct the upper part of the skull. There is no doubt that the two fragments belong to the same skull. From various characters it would appear to be that of a very young person; but the exact age and the sex are difficult to determine. A comparison with the three skulls of Neanderthal man of immature age available—a skull of a child of five from La Ferrassie, the skeleton of a youth found at Le Moustier, and fragments of the skull of a child, perhaps of eight years of age, from La Quina—shows that it agrees with them in the characters in which they differ from those of modern skulls of corresponding age. The measurements, which, however, must at present be regarded as entirely provisional, indicate that the skull is broader in its proportions than would have been expected, nor are the eyebrow ridges and temporal fossæ developed in the manner distinctive of Neanderthal man. The most striking feature in the parietal bone is the fact that the parieto-squamous suture, which is more or less straight in the apes and the human infant and bowed in the adult man, in the Devil's Tower skull is most markedly bowed; but instead of a regular squamous suture, with a bevelled edge, the actual edge of the bone is only recessed very slightly—a condition which is to be attributed to age and not to race. On the provisional measurements which have been made the cranial index works out at 80, a high figure which further consideration may make it necessary to correct.

In view of the very tentative character of the conclusions put forward by Mr. Buxton, it would be premature to offer any comment. Opportunity to appreciate the bearing of the discovery will occur later when the skull has been examined more carefully and the results have been made public at a meeting to be held by the Royal Society. It may be pointed out, however, in the meantime, that its importance is two-fold. It affords some degree of corroboration of the Mousterian date of the Gibraltar skull discovered in 1848 not far from the Devil's Tower site—a corroboration much needed in view of the fact that the collection of implements made at the time of the earlier discovery has disappeared; and secondly, it adds another to the number of skulls of the Neanderthal race, and, what is most important, the specimen is of an age which will add much needed information to our knowledge of the process of growth in that interesting and peculiar variety of early man.

Adhesives and Adhesive Action.[1]

In reviewing the first report of the Adhesive Research Committee, the present writer had occasion to remark on the extreme persistence of the three main types of adhesives, which documentary evidence shows to have been quite familiar to craftsmen of the eleventh century. Believers in proverbial wisdom may incline to the opinion that this familiarity, continued through generations, has indeed bred the contempt with which the subject of adhesion—with or without adhesives—is generally treated in the literature of physics. In this respect the second report breaks entirely new ground in Appendix IV., entitled "Adhesives and Adhesive Action," by Prof. J. W. McBain and Dr. D. G. Hopkins, in which the authors attempt, with a considerable measure of success, to develop rational theories of the mechanism of adhesive action.

The first important conclusion at which they arrive is that there are two fundamentally different types of joints: those between porous surfaces and those between smooth, non-porous ones. In the first type the penetration of the adhesive, while liquid, into the pores of the surfaces to be united is an essential part of the effect. This view is borne out strikingly, apart from much other evidence, by comparison of the strengths of glued joints, made between plain and stained specimens of the same woods; the latter are

[1] Second Report of the Adhesives Research Committee, Department of Scientific and Industrial Research. Pp. iii.+128. (London: H. M. Stationery Office, 1926.) 3s. net.

considerably weaker, as the stain (a spirit varnish) fills the pores and prevents the penetration of the adhesive. It is in complete accord with this explanation that the diminution of strength is less marked with a very porous wood, like deal, than with a closer grained one, like walnut.

For the second kind of joint, that between smooth, non-porous surfaces, the authors postulate some specific action between material and adhesive, and refer to Hardy's views on lubrications. They arrive at the conclusion that any liquid which wets the surfaces and can somehow be transformed into a solid will act as an adhesive for these surfaces. As soon as the statement is put in this form, it would seem to follow quite naturally from considerations of continuity, which does not lessen its novelty or importance. Very remarkable examples of such 'specific' joints are given; *e.g.* shellac joints between metal surfaces with a tensile strength of more than two tons per sq. in. Space does not permit more detailed discussion of the paper, which will be read with profit not only by those interested in adhesives, but also by any one who derives pleasure from seeing a complex problem attacked by the whole armoury of research.

Prof. Schryver briefly describes his attempts to isolate a pure standard gelatin or, incidentally, to decide whether a body of uniform composition answering to this description exists; the results are not conclusive. Dr. J. C. Kernot and Miss N. E. Speer have achieved a result of technical and economic interest by producing from suitably treated fish skins a glue quite free from "an ancient and a fish-like smell," such as in ordinary fish glues is disguised—or, as sensitive people might say, accentuated—by various additions. The same authors in another paper suggest improvements in the manufacture of bone glue. Appendix V. deals with the mechanical tests of adhesives for timber used by the Royal Aircraft Establishment; the general conclusion is reached that the causes of the large variations in the results of timber tests remain obscure, and that "until the degree of these variations has been reduced the present forms of test-piece are unsuitable for experimental or even inspection purposes."

Readers of the report will learn with regret, though without surprise, that important investigations on the manufacture of glue have had to be abandoned owing to lack of financial support from manufacturers—a position which is perhaps explained, though scarcely justified, by the great fall in the price of glue.

E. H.

Herrings along the Baltic Coast of Sweden.

IN *Publications de Circonstance* of the Conseil Permanent International pour l'Exploration de la Mer, No. 89, Chr. Hessle surveys the herring investigations which have been carried on during the past few years along the Baltic coast of Sweden. Nets, both drifting and anchored, land-seines, and big traps are all used for the fishery, but the main part of the total catch is fished by nets. Although the bulk of the fish is landed between July and November, considerable quantities are taken during the winter and early spring. Ice on the water is a severe hindrance to the net fishery during the colder months, and in some places it may put a stop to fishing when, by all evidence, herrings are still present. In the archipelagos nets are sometimes used actually under the ice.

Baltic herrings are characterised by their small size, the low average number of vertebræ, and of the keeled scales behind the ventral fins. In contrast to these, the average number of the first vertebræ with closed hæmal arches is rather high. Both autumn-spawning and spring-spawning herrings occur, the former being of the greater economic value. Catches of autumn-spawners nearly always contain a percentage of spring-spawners, the proportion varying with the season and from year to year. In these catches of mixed fish the spring-spawners are generally smaller in size. This is due partly to the greater percentage of smaller fishes among the spring-spawners, but also to the fact that the rate of growth of the spring-spawners is inferior. In both classes the rate of growth is exceedingly slow after the second or third year. Spawning would seem to occur in the same places for both autumn and spring fish, the former spawning at a temperature of 11°-14°, and the latter at 6°-10°.

In the innermost parts of the archipelagos, and especially in the fjords which penetrate deep into the country of the Middle Baltic, there is a fishery which is based on stationary local races in waters so closed and isolated that sea herring do not enter them. The size and rate of growth of these isolated fjord herrings show a very great variability. Gudingen and Gamlebyviken are two fjords separated only by a narrow strip of land: in Gudingen the rate of growth is quite normal, but in Gamlebyviken sexually ripe fish of only 10 cm. in length have been taken.

Along the coast of the Gulf of Bothnia herrings are caught in traps, fishing commencing as soon as the ice breaks up in the spring, and lasting until midsummer. The bulk of these 'ice herring' are spring-spawners, and a typical feature of the catches is the great number of remarkably large fish which show a peculiar mixture of characters and habits typical of one or another of the races previously dealt with. Altogether Hessle has provided us with a most interesting and instructive paper.

University and Educational Intelligence.

ABERYSTWYTH.—Dr. W. Robinson, senior lecturer in the department of cryptogamic botany in the University of Manchester, has been appointed to the chair in botany in University College, Aberystwyth, in succession to Prof. Lloyd Williams, who retires under the age limit in September.

CAMBRIDGE.—The University Commissioners have published a number of regulations that they have made for bringing into action next term the new statutes governing the General Board and the various faculty Boards. They have also published further regulations which they propose to make—after discussion by the Senate—on the election of members of the Council, degree committees, the Buildings Syndicate, and University finance. The chief point on which discussion is likely to take place is the proposal that members of the Council shall be elected by the method of the single transferable vote. So far as the election of ordinary members of the Regent House is concerned, where four members are elected at a time, this provision is probably suitable, as it will ensure representation on the Council of different groups of electors. It is doubtful, however, whether this method secures the most effective result in the case of the election of the other two groups—(*a*) heads of colleges, and (*b*) professors and readers. Here only two members are elected at a time in each class. So far as University politics is divided into two fairly even parties, this method generally means the election of one candidate from each party—not by any means necessarily the best way of electing an executive body.

Mr. A. Hopkinson, Emmanuel College, has been reappointed demonstrator in anatomy.

THE Air Ministry announces further appointments to short-service commissions in the Royal Air Force to be made in September. Applications are specially welcome from young men who have had some engineering training or have shown a bent towards mechanical matters in their private amusements, as well as from those who are keen sportsmen and have a leaning towards travel and adventure. Short-service officers are taught to fly and at the same time receive instruction in aeronautical engineering, armament, navigation, etc. Service in the R.A.F. counts in part towards the period necessary to become associate members of the Institute of Mechanical Engineers. Applications for regulations should be addressed to the Secretary, Air Ministry, Adastral House, Kingsway, W.C.2. Candidates must be between 18 and 25 years of age, should have received whole-time education at least up to the age of 16 years, and should possess good physique and eyesight.

THE Ramsay Memorial Fellowship Trustees have made the following awards of new fellowships for the session 1926–27:—A British Fellowship of 300*l*., tenable for two years, to Dr. R. F. Hunter, for work at the Imperial College, London; a Glasgow Fellowship of 300*l*., tenable for two years, to Mr. J. D. Fulton, for work at the University of Manchester; a Swedish Fellowship of 307*l*., to Mr. Gunnar Hägg, for work at University College, London; a Swiss Fellowship of 300*l*., tenable for one year, to Dr. Max Brunner, for work at the University of Cambridge. The Trustees have renewed the following Fellowships for a year; Mr. G. A. Elliott (British Fellowship)—at University College, London; Mr. T. Corlett Mitchell (Glasgow Fellowship)—University of Cambridge; Dr. D. McKay Morrison (Canadian Fellowship)—University of Cambridge; Mr. W. G. Burgers (Netherlands Fellowship)—Royal Institution, London; Dr. Ekonomopoulos (Greek Fellowship)—University College, London; Dr. P. Misciattelli (Italian Fellowship)—University of Oxford; Mr. Erik Rudberg (Swedish Fellowship)—King's College, London.

THE League of Nations Committee on Intellectual Co-operation has received from its sub-committee of experts recommendations concerning the instruction of children and young people in the existence and aims of the League. These recommendations raise questions of principle of the highest importance. It is proposed to request Governments to include the subject in their programme of studies and to ensure that the relevant text-books mention it, that education authorities should arrange that in examinations, questions on the League should be set whenever practicable, and that universities should organise special courses of at least six lectures which all students might attend. In addition numerous devices are recommended for propagating knowledge of the League and its gospel, such as the dissemination of books and periodicals, lantern slides, kinematograph films and radio broadcast addresses, special courses for teachers, celebration of League Days at schools, essay competitions, inspirational lectures, and national conferences. The exact place which this instruction will occupy in the curriculum and the time to be allotted to it are, the sub-committee remarks, questions which should be left for the national or local authorities to decide, but it is recommended that it should be correlated with the lessons in "geography, history or civics." Where civics is included in the school curriculum a teacher may fairly be expected to give some instruction about the League of Nations, but where it is not, it is open to question whether such instruction should be smuggled in as "geography" or "history."

Contemporary Birthdays.

August 27, 1865. Prof. James Henry Breasted.
August 28, 1858. Prof. Roland Thaxter.
August 30, 1871. Sir Ernest Rutherford, O.M., P.R.S.
September 1, 1877. Dr. F. W. Aston, F.R.S.
September 1, 1859. Dr. Walter Gardiner, F.R.S.
September 2, 1877. Prof. Frederick Soddy, F.R.S.
September 3, 1882 Dr. William Lawrence Balls, F.R.S.

Prof. J. H. BREASTED, the accomplished American Egyptologist, was born at Rockford, Illinois. His interests early centred in the University of Chicago. Since 1905 he has been professor there in Egyptology and Oriental history. In 1894–95 he was collecting in Egypt for the University, and, later, director of its Egyptian Expedition. In 1920 he was in charge of an archæological survey of Mesopotamia. Prof. Breasted is an honorary fellow of the Society of Antiquaries of London, and D.Litt., Oxford.

Prof. THAXTER, who was born at Newton, Mass., U.S.A., graduated at Harvard Assistant professor of cryptogamic botany there from 1891 until 1901, he later occupied the chair, and he has been, since 1919, emeritus professor. He is the author of many papers on the fungous diseases of insects. Prof. Thaxter is a foreign member of the Linnean Society.

Sir ERNEST RUTHERFORD, president of the Royal Society, Nobel laureate in chemistry, 1908, was born at Nelson, New Zealand. He was educated at the University of New Zealand and Trinity College, Cambridge. After prosecuting research work at the Cavendish Laboratory, he left England in 1898 to occupy the chair of experimental physics in McGill University, returning in 1908. His record of accomplishment in the domain of radioactivity and atomic structure is world known.

Dr. ASTON, Nobel laureate in chemistry, 1922, was born at Harborne, Birmingham, and educated at Malvern College and the University of Birmingham. In 1910 he became one of Sir J. J. Thomson's research assistants at the Cavendish Laboratory, Cambridge. Here it was, under stimulating associations, that Dr. Aston engaged in his classical researches on isotopes. In 1922 the Royal Society awarded him its Hughes medal for his "discovery of isotopes of a large number of the elements by the method of positive rays."

Dr. GARDINER was educated at Bedford, graduating at Clare College, Cambridge. Sometime a science lecturer at Girton, and University lecturer in botany, he received one of the Royal Society's Royal medals in 1898, at the hands of Lord Lister. His researches in vegetable histology established that the protoplasm in the tissues of plants is continuous from cell to cell. Other work of his dealt with the function of tannin, protoplasmic contractility, and the phenomena accompanying stimulation in insectivorous plants.

Prof. SODDY, Nobel laureate in chemistry, 1921, a graduate of Merton, was born at Eastbourne Early, at McGill University, Montreal, he was working under the inspiring guidance of Sir Ernest Rutherford, engaged in researches on radioactivity; afterwards he was with Sir William Ramsay at University College, London, a period when proof was obtained with the spectroscope of the production of helium from radium. Occupant of the chair of chemistry in the University of Aberdeen from 1914 until 1919, he left to become Lees professor of chemistry in the University of Oxford.

Societies and Academies.

CAMBRIDGE.

Philosophical Society, July 26.—P. A. M. **Dirac**: On quantum algebra. In this algebra the commutative law of multiplication no longer holds, but the other axioms of ordinary algebra are still valid. A general definition of a function is proposed, and the differential coefficient is defined without introducing the idea of a limit.—Miss B. **Swirles**: The polarisabilities of atomic cores. The polarisabilities of the cores of several atoms are calculated from the terms of their spectra by means of a formula due to Born and Heisenberg. The values so obtained agree with those given by a modification of the dispersion formula of Kramers and Heisenberg.—J. R. **Oppenheimer**: On the quantum theory of the problem of the two bodies. (Preliminary communication.) In addition to the Balmer terms derived by Pauli, Schrödinger and Dirac, the line intensities are computed; for example, the first Balmer emission line is 12·2 times as intense as the second Lyman line, and the first Balmer absorption line is 5·37 times as intense as the second. The probabilities of transition and capture are derived, and a method of obtaining the deflexion spectrum is sketched. The argument is based throughout on Schrödinger's theory.—G. P. **Thomson**: An optical illusion due to contrast. A blackened strip on a photographic negative sometimes has the appearance of being blacker at the edges than the centre, though the reverse is found to be the case when measurements are made by a photometer. The edges are narrower and clearer the more rapid the transition from light to darkness, but become too narrow to be seen when the transition is made as abrupt as possible. The eye appears to see rapid change of blackness as enhanced blackness. A converse effect appears for a light strip on a blackened ground.—M. H. A. **Newman**: Integral invariants of the affine field.—A. **Young** and H. W. **Turnbull**: The linear invariants of ten quaternary quadrics.—G. S. **Mahajani**: A contribution to the theory of ferromagnetism.—E. B. **Moullin**: On some resistance properties of a certain net-work containing inductances and capacities, and their analogies in a mechanical system. If the net-work is in acceptor resonance at a certain frequency when excited from a particular member, then it will also be in resonance when excited from any other member, but then the resonance may be either acceptor or rejector.—J. C. **Burkill**: On Mellin's inversion formula.—Major P. A. **MacMahon**: The elliptic products of Jacobi and the theory of linear congruences.—R. **Hargreaves**: Geodetic and dynamical principles, a comparison and connexion.—J. R. **Oppenheimer**: On the quantum theory of vibration-rotation bands. The dynamical problem of the diatomic molecule is solved on the new mechanics. The quantum numbers, chosen to give a normal state, are $n = \frac{1}{2}, \frac{3}{2} \ldots$; $m = -\frac{1}{2}, -\frac{3}{2}, -\frac{5}{2} \ldots, \frac{1}{2}, \frac{3}{2}, \frac{5}{2} \ldots$; $r = -m + \frac{1}{2} \ldots, +m - \frac{1}{2}$. The frequencies differ from the classical frequencies for half integral vibrational and rotational quantum numbers in having $m^2 - \frac{1}{4}$ for m^2 in the coupling term. The weights of the m states are $2m$. The intensity of the central line of the band vanishes. The intensities of the lines are worked out to the second order in $\nu_{\text{rot.}}/\nu_{\text{vib.}}$.—P. A. **Taylor**: An approximation to the motion of two rotating electrical doublets in a plane.—D. R. **Hartree**: Some relations between the optical spectra of different atoms of the same electronic structure. (ii.) Aluminium-like and copper-like atoms. For penetrating orbits of the series electron, the quantum defect can be expressed as the sum of contributions from the groups of core orbits of different principal quantum number. Based on this, relations are obtained between the values of the quantum defect for corresponding terms of the spectra of an atom of a given element in different states of ionisation, and of different atoms in such states of ionisation that they have the same electronic structure.—J. P. **Gabbatt**: Note on the extension to higher space of a theorem of Wallace.—J. B. S. **Haldane**: A mathematical theory of natural and artificial selection (Pt. iii.).

ROME.

Pontifical Academy of Sciences (Nuovi Lincei), June.—**Gemelli**: Perception of the position of the body in relation to the sensation of equilibrium of an aeroplane pilot. The importance of muscular, cartilaginous, and tactile sensations, in opposition to those of the semi-circular channels of the ear, is emphasised. Anile, however, reaffirms the importance of such channels with reference to the equilibrium, and states that these studies necessitate consideration of the vast and complex relationships between the vestibular nerve and the nervous centres.—**Luigioni**: A case of trifid antenna in *Demetrias atricapillus*, a small coleopterous insect of the scarab family.—**Teofilato**: Motion of a weight in a medium with viscous resistance.—**Pagnini**: Hypotheses serving as foundation for the undulatory theory.—**Gianfranceschi**: De momento theoriae physicae circa quanta. The bases and the results of the quantum theory are examined and those of real value indicated.—**Scatizzi**: The demonstration of formal generality by means of differential equations of a typical case of the ideal problem.—**Colonnetti**: Experimental investigations on elastic co-actions. Results are given of the study of a rectilinear beam and of a ring subjected to the action of a source of heat which induces in them a state of co-action.—**Giorgi**: Unsolved questions in the fundamental theories of electromagnetism.—Isabella **Biasi**: The extension of Birichbet's theorem to the general typical case of impulsive function.

SYDNEY.

Linnean Society of New South Wales, June 30.—R. J. **Tillyard**: Upper Permian insects of New South Wales (Pt. ii). The orders Mecoptera, Paramecoptera and Neuroptera. These fossils are from Belmont and Warner's Bay and belong to three closely allied holometabolous orders. The Mecoptera are represented by no less than two families, five genera and eighteen species, this being the largest fossil Mecopterous fauna yet discovered, though the Lower Permian of Kansas comes fairly close to it with six genera and fourteen species. This order is also the oldest of the three, as it can be traced back into the Upper Carboniferous. The most abundant genus is Permochorista Till., of which eleven species are described. Fragments of the wings of this genus are the commonest fossils in these beds. The order Paramecoptera is not known outside these beds, and there are only two species; they are interesting as being the early ancestral types from which the orders Diptera, Trichoptera and Lepidoptera have evolved. The Neuroptera are represented by one family, four genera and eight species of the suborder Planipennia.—A. P. **Dodd**: New species of Australian Proctotrypoidea, with revisional notes. One new genus in the family Scelionidæ and ten new species in the families Scelionidæ, Belytidæ and Diapriidæ are described.—G. H. **Hardy**: A new classification of Australian robberflies belonging to the subfamily Dasypogoninæ (Diptera, Asilidæ). Eighteen genera of the Dasypogoninæ are recognised and are divided into three tribes, Brachyrrhopalini (4 genera), Saropogonini (10) and Phellini (4).—May M. **Williams**: Contributions to the cytology and

worker so as to incite him to better work entirely overlooks one important consideration: it is that the manual labourer is a free Englishman, and, like every other freeman he is a merchant. His merchandise is his labour, which it is to his interest to dispose of at the highest price.

It is not a question of the labourer giving less or more according to his mood, but of his fulfilling his bargain. A grocer is not entitled to deliver thirteen or eleven eggs for a dozen according to whether he feels good tempered or bad tempered. In a word 'piece-work' is the one and only remedy for 'ca' canny' and under-production. The real cause for the relatively low wages of the English worker as compared with those of the American is the over-'reproduction' of the former. The wage is the reward for a certain product; the more mouths which have to be fed on this wage the worse off the individual will be.

In countries which have large untapped natural resources, revolutionary experiments may perhaps be indulged in without doing permanent irreparable damage, but in England it is a life-and-death matter to combat them. In a country with such a population that it is unable to feed more than two-fifths of them, our very existence depends on daring private enterprise, just as truly as did that of our Norse forefathers. As Mr. Walter Runcimann, who certainly will not be suspected of Toryism, once put it, "England lives on her business men." It must therefore be our constant endeavour to encourage private enterprise in every possible way, and especially by making its rewards secure, and the very worst manner of doing so would be by limiting the right of bequest.

The dependence of England for its food on foreign trade naturally leads us to the consideration of Sir Daniel Hall's address on the relation between cultivated area and population. Three years ago, at the Liverpool meeting of the British Association, Sir William Beveridge airily disposed of what he termed 'the Malthusian devil' by pointing out what large areas of the world in general and of the British Empire in particular were thinly peopled. His address was exploited by the leading socialist journal under the heading of "Malthusian Moonshine."

Sir Wm. Beveridge's conclusions were severely criticised at the time: and Sir Daniel Hall, speaking not only as a statistician but also as a distinguished biologist, substantially confirms all those criticisms. He points out that the possibility of increase of population is dependent on the increase of food supply, and that between 1850 and 1920 the numbers of the 'white race' increased from 200 to 700 millions. This increase in numbers was rendered possible by the addition of 500,000,000 acres of land to the world's farms: but no further reserves of such lands are to be found on the earth's surface. It is true that the product of those acres might be greatly increased by the adoption of more intensive farming, but intensive farming means greatly increased labour, and even now, despite very much higher wages, the product per man-power is much greater in the lightly farmed lands of Canada and Australia than in heavily farmed England. That the plant-breeder, by the production of better cropping varieties, might increase the yield without necessitating more labour, is conceded, but it will come as a shock to many to read Sir Daniel's opinion as to the narrow limits within which this improvement is to be expected. The main productivity of the plant, he avers, cannot be much increased; all that can be done is to alter the proportions between useful and useless products, such as grain and straw in wheat, sugar and starch in beet, and so on.

The return of the land in food-stuffs per acre is about twenty times greater for wheat than for beef. Further, a considerable portion of our cereal products are employed in producing beer and whisky. If we were all to become prohibitionists and vegetarians we could support a larger population on the same area; but we fully agree with Sir Daniel Hall when he says that the virile and enterprising races, such as have heretofore dominated the world's destinies, would never submit to such a pauperised mode of existence. On the other side of the ledger we have to take account of two grave facts: first, that the fertility of the virgin lands which produced such a great part of our supply is slowly but surely becoming exhausted; and secondly, that everywhere over the world, in Ontario no less than in England, there is the tendency for the rural population to drift into the towns. This tendency Sir Daniel attributes to the poorer rewards offered by agricultural labour as compared with industrial wages in towns. Greatly increased facilities of transportation, wide diffusion of news by wireless and other amenities of civilisation have certainly not diminished the tendency. It will eventually be checked in Sir Daniel Hall's opinion by the better organisation of agricultural workers, who will demand higher prices for the food which they produce. Certainly a cheerful prospect!

It seems to us that the imperative necessity of the limitation of the numbers of the human race in general and of the British Islands in particular is the lesson driven home in sledge-hammer blows by Sir Daniel's able address. If the principle be granted that every human being born in a civilised community may claim the right of full maintenance, whether at work or not, the obvious corollary is that society must be able to control its numbers or become bankrupt.

The Solid Foundation of Organic Evolution.

Evolution. By Prof. J. Graham Kerr. Pp. xii+278+2 plates. (London: Macmillan and Co., Ltd., 1926.) 12*s.* net.

THE object of this book, as set forth in the preface, "is to provide a sketch in outline, approximately correct in its proportions and not overburdened with detail, of the evolutionary science of to-day." The author rightly claims that "a grasp of the main principles of biological science, and amongst these principles Evolution is one of the first, is an essential part of the intellectual equipment of the citizen of the modern state." The necessity was never greater than it is to-day. Although the proceedings in Tennessee last year would have been unthinkable in Great Britain, even amidst the fierce and embittered controversies of the early 'sixties, we often meet with the confident expression of opinions which are all the more injurious because less obviously absurd. Thus in the *Spectator*—on most subjects a sober and well-balanced journal—Mr. C. E. M. Joad wrote in the issue of February 20, 1926, on the causes of evolution: "There were two contemporary explanations in the field; that of Darwin and that of Lamarck. Darwin's was no explanation at all. He said, in effect, that he could not tell why variations occurred; all that he could affirm was that those which were suited to their environment survived." It might with equal force be maintained that the form of a house is not determined by an architect because he did not make the bricks, if I may thus condense an argument employed by Darwin in his correspondence with Asa Gray before the appearance of the "Origin of Species."

Quite apart from this old objection, raised long ago by distinguished controversialists, there is a tendency in these later years to depreciate natural selection, not indeed by contesting its truth but by maintaining that it is self-evident and obvious—a barren guide devoid of inspiration. In Prof. Graham Kerr's book we are provided with admirable and convincing answers to the mistaken opinions of those who maintain that evolution is a delusion, and of those others who admit evolution but deny or depreciate the value of natural selection as its cause. The author's answers are firmly based on a consideration of all the important aspects of the subject—embryology, palæontology, comparative anatomy, geographical distribution, heredity (cytological, statistical, and experimental), natural selection, adaptation, sexual selection, evolution in communities of cells and of individuals, evolution and man, the final chapter containing a summary and the brief discussion of certain general problems of evolution. The book is well and freely illustrated with 53 excellent text-figures and two beautiful coloured plates with well-chosen examples of mimicry in butterflies.

There is something deeply impressive, and to an open mind utterly convincing, in the convergence of so many and such widely different classes of evidence to one inevitable conclusion—the reality of organic evolution. It is not to be expected that the powerful and, in my opinion, irresistible arguments in favour of natural selection as the motive cause of evolution will meet with the same immediate acceptance as those which advocate evolution itself. The latter are driven home by the experience of every biologist; but in estimating the force of the case for natural selection, "the laboratory-trained zoologist lacking in field knowledge often shows a singular incapacity for understanding the importance of evolutionary factors which experience in the field, more especially tropical experience, drives home—such as, for example, the intensity of the struggle for existence or the adaptive significance of animal coloration" (p. 9). There is no doubt about the conclusions to which the author has been led by his own experience in South America. He writes on p. 272: "I adhere to the position of Darwin that the potency of natural selection is in actual fact enormous; I hold that the attempts that have been made to minimise its importance are to a great extent fallacious, invalidated in some cases by their author's want of experience and skill as field naturalists, and in others by the making of unwarrantable assumptions." Prof. Kerr is thus in no doubt about his foundations of belief.

A few slight changes in the excellent Chapter xi., on the "Coloration of Animals," might be advantageously introduced into the second edition, which is sure to be called for at an early date. Mombasa is not one of the localities where the females of *Papilio dardanus* resemble the males (p. 175). If space permitted it would be well to mention the Nairobi district, where ancestral forms of female occur, intermediate between the most primitive of the fully mimetic females and the male-like females of Madagascar and Abyssinia. Different forms of females have not been bred in the same batch of eggs in the Cape district, but in Natal; also in South-East Rhodesia, Southern Nigeria, Uganda, Tanganyika Territory, and of recent years on a very large scale by Dr. V. G. L. van Someren at Nairobi.

The section on "Aromatic Attractions" (p. 186) would be improved by a short account of the advance which has been made along lines originally laid down by Fritz Müller:—Lamborn's observations on male Danaine butterflies brushing the scent-patches on their hind wings and thus charging the anal tufts; Carpenter's, on the actual use of these tufts in courtship; Eltringham, on the minute structure of the scent-producing and

scent-diffusing apparatus of these butterflies and of Phryganidæ.

Returning to Chapter xi., it would be an advantage in such a complicated and difficult subject as butterfly mimicry to adopt a uniform system of illustration, with the models to the left and mimics to the right, and to print "Models" or "Danaine Models," etc., as the case may be, at the head of one column, and "Mimics" at the head of the other. In Plate I. four of the models are to the left, but the fifth butterfly (Fig. 9) would be generally looked upon as a mimic. It appears, however, to be commoner than its model *Heliconius telesiphe* (Fig. 10), but both species are probably distasteful and the mimicry Müllerian. In Plate II. the Danaine models are to right and the mimetic females of *Papilio dardanus* to the left.

The author has been misled, as so many have been, by Bates's use of the word "Heliconidæ" in his classical memoir on butterfly mimicry in the *Transactions of the Linnean Society*. It is extremely difficult, wellnigh impossible, to correct effectually and for all time a mistaken impression conveyed by a great man in his greatest contribution to thought, embodied in a memoir which has been read and re-read unnumbered times and handed on to a widening circle by reprint in hundreds of volumes and journals. It is impossible on the present occasion to discuss this unfortunate result in any detail. It must suffice to explain that the chief models for mimicry among the tropical American butterflies are not the far-famed "Heliconidæ" at all, but a specialised group formerly united with the Danainæ but now placed in a separate sub-family—the Ithomiinæ. These are not only extensively mimicked by other butterflies but also by an important section of the Heliconines. An excellent example is figured by Prof. Graham Kerr on Plate I., Fig. 8, and its Ithomiine model in Fig. 7, but this relationship would scarcely be gathered from the author's words on p. 171, where Fig. 8 is referred to as a "typical example of the . . . Heliconiides." It is by no means typical of these, but only of that large section which mimics the Ithomiines. A far more typical example is represented in Fig. 10 of the same plate. Furthermore, the description of the Heliconiides on p. 171 refers to the Ithomiine and only to those species among the Heliconines which mimic them.

It is scarcely necessary to point out that this criticism, which equally applies to nearly every published account of butterfly mimicry, does not in any way affect the immense strength of the author's argument, and I wish in conclusion to emphasise again the excellence of the work and draw attention to the comfort of its clear type and entire freedom from misprints.

E. B. P.

Sunshine and Health.

Sunshine and Open Air: their Influence on Health, with Special Reference to the Alpine Climate. By Leonard Hill. Second edition. Pp. vii+132+8 plates. (London: Edward Arnold and Co., 1925.) 10*s.* 6*d.* net.

PROF. LEONARD HILL possesses to a marked degree the facility of presenting to his readers a graphic picture of the facts he desires to convey. The first few sentences of his admirable book, "Sunshine and Open Air," vividly and felicitously illustrate this power. "Going out before breakfast at 8 A.M., before the sun has risen over the mountains, one passes into a cold, dry, exhilarating atmosphere, cold enough to make one draw down a cap over one's tingling ears. The snow, crisp with some 10° of frost, crunches beneath the feet. The frosty snowfields glitter with light, and the distant snow peaks of the mountains, catching the sun, blush rosy red; the pines stretch upwards their black boughs drooping heavy with snow." We are transported at once to the scene he so graphically visualises. He writes not only as a scientist but as a poet; and when a few lines further on he says, "So one comes back with a good appetite for breakfast after an hour's climb," we almost feel the healthy hunger that morning walk over the enchanting snow-clad mountains has aroused, and plunge with added zest into a book readable from cover to cover, and replete with information and original observation.

The author considers the characteristics of the Alpine climate and on which of these its curative value is based, contrasting the outdoor English climate on one hand, and the indoor city conditions on the other, with these Alpine conditions. He finds no evidence of differences in atmospheric pressure ionisation of the air, or in chemical purity being of importance. The important factors are:

(1) Freedom of the air from pollution with infectious microbes, dust, and smoke which prevails in indoor city atmospheres.

(2) A high physiological saturation deficit; that is, a large difference between the water vapour in a cubic metre of air at atmospheric temperature and that held in the air when saturated at body temperature. On this depends the evaporation from skin and lung. The evaporation from the lung entails passage of blood and lymph through the respiratory membrane and a secretion which cleanses and immunises against infection. In crowded, warm rooms the physiological saturation deficit is lowered while microbic infection is increased, and with it the natural defensive cleansing

mechanism. The free evaporation from the skin is also of much importance to comfort and health.

(3) High drying power ensures dry clothes, houses, and soil; and these warmed with abundant sunshine prevent uncomfortable loss of body heat by radiation.

(4) Cool dry air stimulates the skin and exhilarates the feelings while keeping up the loss of body heat to an adequate level, maintaining appetite and good digestion.

(5) At night the cool air descending from the mountains prevents stuffy, warm conditions in the summer and gives an exhilarating change to the warm sunny day conditions. In winter the frosty cold air, with absence of wind, affords exhilarating conditions for sleeping in open-air balconies, the very antithesis of the stuffy, warm, stagnant, moist air of crowded city rooms which lowers the rate of cooling of the body and with this the respiratory metabolism. The absence of high wind prevents excessive cooling in the Alps.

(6) The sunshine, with its plentiful supply of ultra-violet light, acts beneficially on the skin and so on the general health.

The author discusses in detail the evaporative power of the air exerted on the body, the biological action of light, the cooling power of the air and its marked effect on the resting metabolism and heat production of the body.

In a volume so valuable and informative it is difficult to select special sections particularly deserving of mention, but in the concluding chapter is a section devoted to clothing which is of great practical interest. The author protests against excessive clothing, by which the natural vigour of the body is weakened. "It does no harm to go out and feel cold until warmed by exercise; the impulsion to vigorous exercise does good. It is only the old and feeble who require very warm clothing, those whose fire of life cannot be fanned up by vigorous exercise and exposure." Prof. Hill practises on himself his own preaching. He concludes his book by confessing: "The writer finds a light cellular shirt and pants and a woollen tweed suit ample for winter, and rarely wearing an overcoat, keeps himself warm and in good condition by walking on every possible occasion, covering to and fro from his place of work and in a walk before breakfast some five miles a day, and at week-ends having, whenever weather allows, a sunbath."

In a short appendix artificial light treatment is very briefly discussed.

"Sunshine and Open Air" is well worthy of careful study. The information it conveys cannot be too widely known and applied. Acquaintance with the facts described would do much to teach essential principles of sound hygiene and sensible care of the body. There is a lucidity and charm in this volume which adds greatly to its value. After perusal one cannot but wish that the author should be persuaded to issue an abridged edition suitable for the widest possible circulation amongst medical men, nurses, teachers, parents, and indeed all those who are concerned with and influence the management and upbringing of youth. Prof. Hill has rendered valuable service in producing a volume which may be commended in the highest terms as of great scientific and utilitarian merit.

Vacuum Practice.

Vacuum Practice. By L. Dunoyer. Translated by J. H. Smith. (International Text-Books of Exact Science.) Pp. x+228. (London: G. Bell and Sons, Ltd., 1926.) *12s. 6d.* net.

It must be very difficult to write a book on this subject, for it has to cover such a wide and varied range. There are two distinct aspects of the matter, theoretical and practical, both important and interesting. A complete exposition of the theories involved would require almost an entire text-book on physics, new and old; and most of them are still attended by considerable uncertainty. The practical side is no easier to treat: for practice is best taught by example and not by precept; and yet perhaps it is the more important. The principles—at least, of the theories—lie on the high road of academic physics and form a normal part of the training of every serious student; but the practice has developed in the factory rather than in the laboratory, and its literature consists of patent specifications rather than formal papers. In most of the university laboratories of Great Britain, the best designed and best executed piece of vacuum apparatus that they contain is the incandescent vacuum lamps (already almost obsolete) by which they are lit; and many a skilled experimenter with years of pure research behind him would be quite unable to produce such a common domestic article as a 'dull-emitter' valve. The reason lies partly in the lack of equipment from which all British universities suffer, but far more in the gulf between the followers of pure and applied science, which is only slowly being bridged.

No apology would therefore be needed (nor is any offered) for the appearance in English of a third book covering the same ground as those of Dushman and Newman, even if it possesses no merit that they lack. Actually in one respect M. Dunoyer's book is greatly superior to either. It is critical. Dushman dealt mainly with work in which he was so closely concerned

that he is not in a position to criticise; Newman aimed chiefly at being encyclopædic. M. Dunoyer has passed all the work through his own mind, and offers his opinion freely. His presentment is therefore better, and his book more readable; he has been greatly assisted by a translator of complete competence and sufficient wisdom to risk slang, if only he may avoid Gallicisms.

If fault has to be found with M. Dunoyer—and how else can a reviewer display his omniscience?—it must be sought in his selection of material. He tells us that his principal object is the study of technique. But then would it not have been well to sacrifice some part of the theory of monomolecular absorption to a recipe for making 'activated' charcoal (for which every investigator has his pet method) or even to advice in constructing ovens for baking during absorption? Would not a few details of the commercial process of 'gettering' be worth as much as the somewhat nebulous theories that have been advanced to explain it? Why should Knudsen's theory of gas-flow at low pressure be carried beyond the point at which it has any practical application, while Gaede's theory of diffusion is left before it has indicated the effect of dimensions and temperature on the performance of the pump, or even the relation between speed and the nature of the gas pumped? Lastly, the simple theory of metal to glass constructions is quite as interesting and much more practical than many others for which space has been found.

We would not leave the impression, however, that M. Dunoyer has not lived up to his professions. He is most admirable when he is most practical. He is really helpful in the sordid matter of leaks; he knows all about waxes and cements, but realises their limitations; and, though he writes before the recent startling developments in this direction, is aware that metal to glass joints are not so difficult as the amateur believes. But even in these matters his outlook is not perhaps quite that of the professional expert. It is possible, and indeed easy, to be too ingenious in leak-hunting; in most circumstances a leak which cannot be found by simple means in a few minutes is best eliminated by reconstruction. The disadvantage of waxes is not their vapour-pressure, but their low melting-point; apparatus which involves them cannot be baked. If so much is said of the physical properties of these makeshifts, surely some attention should have been paid to the physical properties of the essential material, glass. In Great Britain, nearly all laboratory workers continue to handicap themselves by the employment of treacherous and generally unsuitable soda glass; they seem never to have heard of the lead and borosilicate glasses; a table of comparative thermal and electrical properties would do much to enlighten their ignorance.

There is only one matter, other than a choice of material, in which we differ seriously from M. Dunoyer. In his discussion of gauges, the account of the characteristics and limitations of the various types is excellent; but when he sums up in favour of a form of Knudsen gauge against the ionisation gauge, he misconceives the problem and might mislead a novice. A gauge is often used merely to indicate that a certain rough limit of pressure has been reached; for this purpose all that is needed is sensitivity, simplicity, and ease of attachment; in all these the ionisation gauge is vastly superior to the Knudsen. Sometimes only relative accuracy is required in the comparison of different quantities of the same gas; here again the dependence of the calibration of the ionisation gauge on the nature of the gas in immaterial. The Knudsen gauge is superior only if an absolute measure is required of mechanical pressure or of number of molecules per unit volume; the requirement is so rare and arises only in such elaborate researches that it should not be taken into account in offering a general recommendation

NORMAN R. CAMPBELL.

Geography and Geology of Makalla.

Ministry of Finance, Egypt: Survey of Egypt, Geological Survey. The Geography and Geology of Makalla (South Arabia). By O. H. Little. With Two Appendices: (i.) Description of Fossils from South Arabia and British Somaliland, by Prof. G. Stefanini; (ii.) Note on some Terrestrial Mollusca from the Hinterland of Makalla, by P. Pallary. Pp. xi + 250 + 36 plates. (Cairo: Government Publications Office, 1925.) 50 P.T.

THIS volume is the outcome of two expeditions led to Makalla at the request of the late enlightened ruler Sir Ghalib bin Awad bin Omer el-Kaitai, K.C.I.E., Sultan of Shehr and Makalla. Makalla is located on that little frequented coast-line of Arabia between Aden and Muscat. Under the impression that minerals of economic value existed in the territory he ruled, the Sultan requested the British Government to undertake an examination. A reconnaissance survey was made in May 1918, but so great are the difficulties of travel, and so lawless the tribes outside the immediate control of Makalla, that even under the protection of the Sultan's troops geological work is greatly hampered and every excursion is, in fact, an adventure.

The later and more detailed survey of Mr. Little confirmed the view that there were no minerals of economic value in the country even if the difficulties of access were surmountable. Exaggerated importance is attached

by the Bedouins to any unusual rock or mineral, and the slightest attention from a European is sufficient to convince them that something of enormous value exists.

Every tribe claims the right of imposing tribute on travellers passing their territory, even if permission is granted, and camels must be hired in the country being traversed. Any departure from recognised custom invites trouble, and the country is very convenient for ambushes. A virulent form of malaria prevails in the swampy regions along some of the nullahs and near the sea, and many of the expedition were incapacitated for long periods. The heat is very trying from May onwards, and even at night the air breathed resembles furnace gases at times. The tribes do not trust each other, and any unusual sound at night usually results in an outburst of wild firing from any strange party encamped in hostile country. One member of Mr. Little's party was, indeed, murdered shortly after he had left the main body.

The physiography of the region is extremely fascinating, as the interior is reached by traversing deep wadis which narrow down at times to cañons with precipitous sides, 1000 to 1500 ft. high. Men and animals trapped by a sudden flow of water due to rains in the interior can find no escape. At intervals these cañons are broken by steep falls, which make it necessary to climb out of the gorge by a zigzag track to reach a higher stretch. Immense boulders strew the path in these gorges and at times exceed 1000 cubic metres in size. Water disappears and appears in some at intervals where the valley floor is pervious or impervious.

Some of the roads, which traverse narrow spurs and ridges leading into the mountains of the interior, are so steep and so polished by the constant treading of the bare feet of men and camels that passage is exceedingly dangerous, and both animals and men occasionally lose their lives through falls of many hundreds of feet.

Sufficient fossils were found to distinguish the age of the sedimentary rocks. Beds of Pleistocene, Pliocene, Miocene, Oligocene, Eocene, Cretaceous, and Jurassic age were recognised. The Pliocene conglomerates appear to correlate with the Bakhtiari series of the Persian Gulf and the great calcareous conglomerates of Somaliland.

The Miocene beds are not well developed and are gypseous in character; they are thought to correspond with the Fars series of the Persian Gulf, and they resemble the Miocene gypsum series of Egypt. It is, however, the Eocene and Cretaceous beds which cause the most striking topography of the country. Imposing vertical scarps 1500 feet and more in height often border the side of the wadis and the edges of valleys. The middle Eocene semi-crystalline limestones reach sometimes a thickness of nearly 1000 ft., and they overlie a series of massive variegated sandstones of Cretaceous age approximating another 1000 ft. in thickness. Where the Jurassic is absent these Cretaceous beds directly overlie the igneous basement rocks. Apart from occasional granites the igneous rocks are basic in character. Lignites are found in the Cretaceous sandstone series, while oil shales occur in the Jurassic rocks.

The only mineral deposits of any likely value are the lignites and oil shales, but neither are in sufficient bulk to warrant development to-day.

Two appendices with excellent illustrations describe the fossils of Southern Arabia and Somaliland; consequently the volume will prove valuable to all those studying the geology of that part of the world. The country and the customs of the inhabitants are admirably described, and many useful hints may be obtained by would-be travellers in these wild regions.

A. B. T.

Our Bookshelf.

Commission Internationale de l'Éclairage en succession à la Commission Internationale de Photométrie. Sixième session, Genève, Juillet 1924. Recueil des travaux et compte rendu des séances. Publié sous la direction du Bureau Central de la Commission, the National Physical Laboratory, Teddington, Angleterre. Pp. 432+19 planches. (Cambridge: At the University Press, 1926.) 15s. net.

THE initial portion of this comprehensive volume contains a list of the members of the International Illumination Commission, an account of the proceedings at the various meetings, and a summary of the chief decisions taken. The Commission recommends the initiation of researches on the incandescent black body as a primary standard of light, and adopts a series of values for the relative visibility factor for light of different wave-lengths. A series of terms and definitions for international adoption (in French) is also presented. In an appendix, recommendations on the lighting of schools and factories, presented by Mr. L. B. Marks, the chairman of the committee devoted to this subject, are reproduced. Values of illumination range from 0·2 to 50 lux (approximately 5 foot-candles) according to the purpose served by the light.

The remainder of the volume is devoted to papers read. These fall into several well-defined groups. Amongst those of a more purely scientific character may be mentioned researches on the primary standard of light, characteristics of tungsten lamps, notes on symbols and nomenclature, and heterochromatic photometry. A new feature is the inclusion of several papers dealing with educational propaganda in favour of good lighting, and illustrating methods of cooperation between supply undertakings, manufacturers, and the public in the United States. There are several papers dealing with the public lighting of Paris and with motor-headlight problems. Finally there is a

group of papers by representatives of different countries dealing with industrial lighting. The various papers presented thus cover a wide ground, and it is evident that the work of the Commission is extending. The interchange of views between experts in different countries is helping towards the formulation of common principles of illumination, and it is to be noted that international committees are now engaged on a variety of problems.

The Historical Geography of Early Ireland. By Walter Fitzgerald. (*The Geographical Teacher* Supplement No. 1.) Pp. vii + 100. (London: George Philip and Son, Ltd.; Liverpool: Philip, Son and Nephew, Ltd., 1926.) 5*s*. net (to Members of the Geographical Association, 4*s*. net).

THIS work is worthy of a better exterior. A closely printed pamphlet is apt to repel a reader, who would peruse with delight the same matter in an attractive book. Having said this, and having added a word of censure on the poor scratchy drawings of gold ornaments (p. 70), we proceed to the pleasant task of commendation. Mr. Fitzgerald has undertaken, and has done well, a work long overdue; although the way was prepared by the late Prof. Cole's short but notable "Ireland the Outpost." In the past the history and antiquities of Ireland on one hand, and her geology and geography on the other, have received attention; Mr. Fitzgerald shows the inter-relation of the two sets of facts. The first half of the book is occupied with geography, and is illustrated with many valuable maps; the second half is archæological and historical, and is likewise illustrated with maps of the distribution of types of implements, roadways, colonisation-areas, the routes of early Irish enterprise on the Continent, etc.

We sincerely hope that the author will expand his work into a 'full-dress' book, and we venture in anticipation to offer a friendly hint or two. 'Gacillon' (p. 63) should be *Gaileoin*: 'Ushnagh' should be *Uisneach*. The Cat-stone is not on this hill, but on the slope of the hill next to it; and it is not a dolmen, but a large erratic boulder (the author has been misled by Borlase's imposing but unsatisfactory "Dolmens of Ireland," which should be used with discretion). And let him be cautious about taking literally the legends of the Tuatha Dé Danann; the complex stratification of these strange tales must be worked out much more critically than has yet been done, before they can be safely utilised in a study such as this.

R. A. S. MACALISTER.

Coal: Ways to Reconstruction. Being a Sequel to "The Coal Crisis and the Future." By Members of Leplay House. Pp. vi + 58. (London: Leplay House Press, 1926.) 2*s*.

THIS volume consists of a number of articles by various contributors, and, as is stated in the preface, the studies are both complementary and divergent. The main thesis, however, is that reconstruction in the coal industry is to be effected by means of regional planning. The application of the surveys is to be based on the co-ordination of the recommendations of the several experts, while the corresponding theory of the "transition from the confused empiricism of current business and politics to an ordered advance" is to be supplied by the sociologist. Prof. Geddes contributes an interesting summary of the methods of regional planning, and advocates regional surveys of the coal districts as a preliminary to the solution of the problem. Then follow articles by Prof. Desch and Prof. Hay, who both emphasise the importance of better methods of coal utilisation. The former deplores the present wasteful methods, while the latter holds that there is more hope for the industry in improved systems of coal consumption than in reorganisation of the mines.

Prof. Hay's thoughtful survey, which can be commended to those interested in the problem, stresses the importance of a greater production per man-shift, the development of markets, and the stabilisation of prices. At the same time he pleads for more understanding among the various parties, consumer, owner, and miner. An abstract of a previous volume is given by Mr. Sandeman, while Mr. Victor Branford contributes a theoretical exposition illustrating the application of sociological principles.

Superpower: its Genesis and Future. By William Spencer Murray. Pp. ix + 237. (New York: McGraw-Hill Book Co. Inc.; London: McGraw-Hill Publishing Co., Ltd., 1925.) 15*s*. net.

THE term 'superpower' is used to indicate a "greater unity of effort and broader co-ordination in (electrical) power production and utilisation." The author was chairman of a committee authorised by Congress to study the possibilities of superpower in the Boston-Washington zone. This committee began its activities in July 1920 and twelve months later presented its report (*Professional Paper* 123, U.S. Geological Survey).

The present book is to some extent an amplification of that report. It contains many interesting reflections and personal touches which will make it good leisure-time reading to those who have read the original report. A wide survey of the problem is made and a considerable portion of the book is devoted to finance, but the difficulties involved in standardisation of frequency and the stereotyping of generation and distribution methods in an age of rapid progress do not appear to have been dwelt upon sufficiently.

W. T. D.

A Bibliography of Indian Geology. Part IV. Palæontological Index. Compiled by T. H. D. LaTouche. Pp. iv + vii + 414. (Calcutta: Government of India Central Publication Branch, 1926.) 7.4 rupees; 11*s*. 6*d*.

SINCE his retirement from the Geological Survey of India, Mr. T. H. D. LaTouche has devoted his leisure time to the great task of compiling a bibliography of Indian geology. Part I. A gives a list of authors' names in alphabetical order with the titles of their papers arranged chronologically; Part I. B is an index of minerals; Part II. an index of localities; Part III. an index of subjects. Part IV., which has just been issued, gives an alphabetical list of the species of Indian fossils, followed by references to the works in which each species is described. This index will be indispensable to palæontologists whether they are dealing with the fossils of India or of other countries.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Recurrence of Magnetic Storms.

IN recent communications to the French Academy of Sciences Prof. H. Deslandres (see NATURE, vol. 118, p. 71), the distinguished director of the Meudon Observatory, has described a tendency in magnetic storms to follow one another at intervals $iT/6$, where i is integral, T being the rotation period shown by sunspots. It is now, I think, generally agreed that there is a tendency to a repetition in magnetic conditions, whether disturbed or quiet, in what is described for brevity as the 27-day interval. Investigations (*Phil. Trans.* A, vol. 212, p. 75, and A, vol. 213, p. 245) which I made in 1912 and 1913 showed a tendency to recurrence in intervals which were multiples of T, but in none shorter. Supposing in accordance with modern ideas, as seems to have been first suggested by Kr. Birkeland, that magnetic storms are due to the discharge of ions from the sun, if such discharge, whether from sunspots or other approximately fixed limited areas, went on for a long time, a repetition of disturbance according to the solar rotation period is exactly what we should expect. But repetition at intervals submultiples of T would suggest a different explanation, namely, that the sun as a whole acts somewhat like an intermittent geyser. The subject seemed so important both to magneticians and astronomers that I have further considered it.

Some things fairly patent to magneticians may be less so to others. A magnetic storm is not definable with the same precision as a solar eclipse. It is true that an eclipse commences at different times at different parts of the earth, whereas the S.C. (sudden commencement) of a magnetic storm may, for all we know, be absolutely simultaneous all over the earth. But many storms have no S.C.'s, and, when S.C.'s occur, highly disturbed conditions may not follow for some hours. Thus, in general, the time when a storm begins at a particular station, and still more the time when it ends, cannot be specified exactly. Again, there seems to be at all stations a marked diurnal variation in disturbance, and this renders it extremely difficult to estimate to the fraction of a day the interval between successive storms.

The accompanying table gives some of the results which I have obtained. The results all ultimately depend on daily character figures assigned on the international scheme 0 (quiet), 1 (moderately disturbed), and 2 (highly disturbed), and they further depend on the selection of five highly disturbed days a month. Take, for example, the 11-year data distinguished by the letter A. The entry in column n is the mean character figure from the $5 \times 12 \times 11$, or 660, selected disturbed days, the entry in column $n+1$ the mean character figure from the 660 days immediately following these selected days, and so on. In the case of A and B, the 5 days selected for each month were the days of largest horizontal force range at Kew. A includes the whole eleven years 1890 to 1900, while B represents only three of these years, 1891, 1895, and 1896, selected for a special reason. In the case of A and B the daily character figures depended entirely on the estimate of disturbance at Kew. In the case of C and D the selected days were the days of largest international character figure, and use was made of the daily international character figures which range from 0·0 to 2·0. C includes six years, 1906 to 1911, and D five years, 1920 to 1924.

If, to take a round figure, we suppose 27·0 days to be the solar rotation period, M. Deslandres' conclusions would suggest maxima answering to days $n+4·5$, $n+9$, $n+13·5$, $n+18$, $n+22·5$, $n+27$, and $n+31·5$. As disturbance is seldom limited to a few hours, we should expect to find maxima in the table in columns $n+9$, $n+18$, and $n+27$, and to perhaps a minor extent in columns $n+4$, $n+5$, $n+13$, $n+14$, $n+22$, $n+23$, $n+31$, and $n+32$. High disturbance is seldom confined to single (Greenwich) days. It is not unusual for it to extend to 3 or 4 consecutive days, and sometimes even to 6 or 7. This explains

	Mean.	$n-3$.	$n-2$.	$n-1$.	n.	$n+1$.	$n+2$.	$n+3$.	$n+4$.	$n+5$.
A	0·70	0·64	0·77	1·05	1·51	1·11	0·86	0·77	0·70	0·66
B	0·84	0·77	0·94	1·22	1·73	1·32	1·06	0·96	0·87	0·76
C	0·66	0·57	0·67	0·95	1·32	1·02	0·77	0·66	0·65	0·63
D	0·58	0·53	0·63	0·90	1·30	0·94	0·69	0·55	0·47	0·47

	$n+6$	$n+7$.	$n+8$.	$n+9$	$n+10$	$n+11$.	$n+12$.	$n+13$.	$n+14$.	$n+15$.
A	0·62	0·63	0·64	0·62	0·61	0·63	0·63	0·63	0·64	0·63
B	0·68	0·73	0·74	0·73	0·70	0·75	0·75	0·81	0·84	0·80
C	0·63	0·65	0·64	0·62	0·59	0·59	0·59	0·60	0·59	0·57
D	0·48	0·53	0·52	0·54	0·53	0·53	0·55	0·54	0·54	0·57

	$n+16$.	$n+17$.	$n+18$.	$n+19$.	$n+20$	$n+21$.	$n+22$.	$n+23$.	$n+24$.	$n+25$.
A	0·63	0·63	0·61	0·61	0·62	0·64	0·64	0·63	0·65	0·71
B	0·82	0·78	0·70	0·74	0·77	0·74	0·78	0·76	0·84	0·87
C	0·60	0·61	0·62	0·63	0·63	0·63	0·63	0·62	0·62	0·65
D	0·57	0·58	0·58	0·58	0·53	0·52	0·48	0·49	0·52	0·59

	$n+26$.	$n+27$	$n+28$.	$n+29$.	$n+30$.	$n+31$.	$n+32$.	$n+33$.	$n+34$.	$n+35$.
A	0·83	0·94	0·92	0·84	0·79	0·72	0·70	0·67	0·64	0·61
B	0·98	1·13	1·15	1·02	0·94	0·82	0·79	0·73	0·72	0·66
C	0·75	0·84	0·81	0·75	0·70	..	..	..	..	..
D	0·74	0·83	0·76	0·67	0·60	0·54	0·52	0·51	0·54	0·55

why outstandingly high mean values are not confined to column n, but extend to at least columns $n-2$ and $n+2$. The existence of high mean values for the five columns $n-2$ to $n+2$ entails values somewhat below the all-day means (given in the first column) in the majority of the other columns. Individual years give usually somewhat irregular results, and minor irregularities appear even in 11-year data. But it will probably be admitted that in addition to the primary disturbance pulse extending from column $n-2$ to columns $n+3$ or $n+4$, A shows clearly only one secondary pulse, extending from column $n+25$ to column $n+30$, or possibly $n+31$. The maximum appears in column $n+27$, with column $n+28$ not far behind. The three years included in B are given separately because they rather suggest a minor peak value in column $n+14$. But as the B results form a part of the A results, this is presumably purely accidental. Again, the D results may suggest a small secondary peak centring about column $n+17$, but there is no suggestion of this in the C results. The full 27-day interval is shown particularly clearly in D, which includes the latest international data available. No entry from column $n+3$ to column $n+24$ exceeds 0·58, the all-day mean, while the entry in column $n+27$ exceeds this by 0·25. Magnetic disturbance is the rule rather than the exception, and in the absence of any exact definition of a magnetic storm it is specially necessary to study the phenomena with an unprejudiced mind. The method employed here ensures impartiality. The table does not seem to me to suggest any real recurrence interval

shorter than 27 days, but any one can judge for himself.

Obviously, if two or more solar areas are highly active simultaneously, for a time which includes several rotation periods, we may have several pairs of (unconnected) storms separated by approximately constant time intervals, which might happen to be approximately sub-multiples of 27 days.

C. CHREE.

75 Church Road, Richmond, Surrey,
July 29

Prof. Labbé's Production of 'Allomorphs' by the Action of increased Hydrogen Ion Concentration.

PROF. LABBÉ, in a series of recent papers (*C.R. Acad. Sci.*, Paris, 1924, t. 178, p. 132, 594; t. 179, p. 928; 1924, *Arch. Zool. Exp.*, t. 62, p. 401), has communicated the results of observations made on the Salines of Croisic, and the conclusions he draws therefrom as to the nature and stability of species would, if substantiated, seriously shake the foundations of systematic zoology. For example, he asserts that, from the eggs of a parent form *Canthocamptus minutus* O.F.M. exposed in the ovisac to the influence of a high P_H, he has obtained a mixed progeny consisting of:

(*a*) *C. minutus* (typical).
(*b*) 'Allomorph' *Mesochra* (*Wolterstorffia*) *blanchardi* Rich.
(*c*) 'Allomorph' *Canthocamptus lucidulus* Rehb.
(*d*) 'Allomorph' *Mesochra salina* n. sp.

From these and other results Labbé draws very far-reaching conclusions which will, no doubt, receive serious consideration from all concerned with biochemical investigations; and it is possible that many will accept the premisses on which the conclusions rest without the close critical study which is the province of the systematist. For this reason the following remarks may be justified. I will take only the example given above of *C. minutus* and its 'Allomorphs.'

(1) 'Allomorph' *C. lucidulus* Rehb. In the first place one may observe that *C. lucidulus* is a common *fresh*-water species; secondly, the descriptions and figures given (*Arch. Zool. Exp.*, 62) are sufficient to show that the specimens described did not remotely resemble *C. lucidulus*. The antenna figured (Fig. 17) is unlike that of any Harpacticid of which I can find a description, since in all 8-jointed antennæ[1] the æsthete or "organ of Leydig" is borne by the fourth joint, which is followed by four more small joints; whereas in Labbé's figure it is borne on the fifth, and followed by two joints only. The fifth legs of both male and female (Figs. 28 and 29) are not only totally unlike those of *C. lucidulus* but have no parallel among Harpacticids. I can only call to mind two examples of a fifth leg having a two-jointed exopod—*Misophria pallida* and the male of *Microthalestris forficula*. It is conceivable that Labbé's figures are inaccurate drawings of swimming legs of immature individuals; but they are quite certainly not those of the fifth leg of *C. lucidulus*. Lastly, the operculum of his allomorph is, as he admits himself, quite different from that of *C. lucidulus*.

(2) 'Allomorph' *Mesochra blanchardi* Rich. Fig. 31 of the fifth foot bears some resemblance to that of *M. blanchardi*, but those of the antennæ, the furca and the first leg do not. The antennæ, if correctly drawn, can only be interpreted as monstrosities.

[1] Labbé's figure shows seven joints only, though all species of the genus have eight. The legend of the figure is "Canthocamptus minutus O.F.M. ♀ Antenne antérieure gauche de l' 'allomorphe' " and presumably is intended to represent that of "Allomorphe Canthocamptus lucidulus Rehb."

(3) 'Allomorph' *M. salina* n. sp. Here there is no question of alleged identity with a known species, but Labbé states that it differs from *M. blanchardi* only in the structure of the fifth legs. Curiously enough Fig. 32, which is said to represent the fifth leg, is so nearly like the *first* leg of *M. blanchardi* that (apart from a discrepancy in the proportional length of the joints) it might represent that limb, while Fig. 26 of the first leg represents an appendage described in the text as the fifth, but quite unparalleled among known Harpacticids.

Similar criticisms might be directed upon the 'Allomorphs' *Eurytemora affinis* and *E. lacustris*, while the remarks concerning *Artemia salina* are open to serious objection.

The experimental methods are so briefly described that any one acquainted with the difficulties of breeding Copepods without accidental introduction of the Nauplii of other species cannot fail to be sceptical of the results. Prof. Labbé's statement that the parents died on being placed in the new medium, but that their eggs were successfully hatched, leads one to doubt very much if the larvæ observed actually came from those eggs. In the brackish water such as fills the Salines at Croisic in winter, a number of Harpacticids may be expected to occur—*e.g.* species of Amphiascus and Nitocra—and it seems quite probable that the unsuspected presence of such species may have vitiated the results.

Having regard to the importance of the questions at issue it is essential that the foundation of fact should be impregnably secure, and it is to be hoped that, before Prof. Labbé's conclusions are accepted, he will be required to produce not only a detailed account of his experiments, but also accurate figures of his 'Allomorphs.'

I do not find anything at present in his writings which "fera malheureusement le désespoir des morphologistes classificateurs."

ROBERT GURNEY.

Stalham,
Norwich.

Scattering of Electrons in Helium.

THE energetic relations in collisions between electrons and gas molecules have been made the study of a very large group of workers, all of whose results show the essentially unmechanical nature of the processes involved. Our picture of the nature of such a collision must remain incomplete, however, until the angular relationships of the electron and molecular paths are also known.

Such information as we already possess of the scattering of electrons is in the highest degree unexpected. The work of Ramsauer has shown that slow electrons in the rare gases possess free paths much longer than would be anticipated on the kinetic theory, while that of Davisson and Kunsman (*Physical Review*, **22**, 242, 1923), on the scattering in metal films is also of revolutionary character. Quite recently Langmuir (*Physical Review*, **27**, 806, 1926) has shown that inelastic collisions in several gases lead to very small angles of scattering. Elsasser (*Die Naturwissenschaften*, **13**, 711, 1925) has put forward an explanation of these results on the basis of the theory of de Broglie, in which a moving particle is associated with a 'phase wave,' the interference of which governs the scattering.

In the course of an investigation of the energy distribution of electrons after a collision with a gas molecule, it was found possible to study at the same time the angular distribution of scattering.

Electrons from a tungsten filament were restricted by two slits to a narrow beam and traversed the gas under investigation, which was helium at a pressure of 0·03 mm. A beam of scattered electrons could be selected by two slits and afterwards bent in a magnetic field to determine the velocity distribution. Fast pumps maintained a low pressure in this region. The filament and first two slits could be rotated, so that the scattering angle could be varied from 0° to 90°.

The results for the scattering of electrons, which have suffered inelastic encounters and have lost 20 volts energy, are shown for two initial velocities, $V_i = 100$ and $V_i = 400$ volts, in Figs. 1 and 2. For $V_i = 100$, there are two maxima, the principal one at 5° agreeing with the observation of Langmuir, and another, much broader, at about 60°. For $V_i = 50$, the principal maximum broadens and moves to 20°. At higher initial velocities this maximum moves to smaller angles and for $V_i = 200$, is at less than 2·5°,

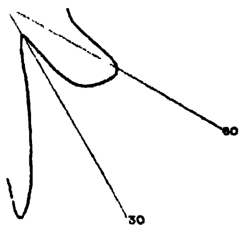


FIG. 1.—Scattering of electrons losing 20 volts energy; initial velocity, $V_i = 100$.

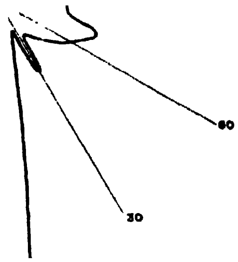


FIG. 2.—Scattering of electrons losing 20 volts energy, initial velocity, $V_i = 400$.

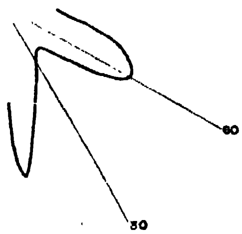


FIG. 3.—Scattering of electrons losing no energy; initial velocity, $V_i = 400$.

the smallest angle at which measurements could be made. At the higher velocities a very remarkable third maximum appears at 30°, which is much sharper than the other two. It is found first at 200 volts and increases in importance to 400 volts, which was the highest point at which measurements could be taken. The position of this peak was found to be independent of the velocity. This type of scattering is limited to the inelastic collisions, as is shown in Fig. 3, which shows the distribution of 400 volt electrons which have lost no energy, and is very similar to that of 100 volt electrons that have lost 20 volts energy (Fig. 1).

The occurrence of these maxima is strongly suggestive of an interference pattern, as suggested by Elsasser, but the fact that the position of the sharp maximum at 30° is independent of the velocity does not agree with his explanation.

It is hoped to extend this work to higher velocities and to the case where collision leads to ionisation and not excitation of the atom.

E. G. DYMOND.

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June 18.

Intensity and Polarisation of Skylight at Sunrise and Sunset.

IT is now well-established that the illumination of the clear day-sky at high-level stations is almost entirely due to molecular scattering by the atmosphere. The remarkable changes in the character of sky-illumination which take place when the sun approaches and gets below the horizon have been the subjects of study of a number of investigators and in recent years, particularly of Profs. Dorno[1] and Gruner.[2] Some of the phenomena, as for example, the changes of colour and polarisation of skylight and the appearance of the earth-shadow, occur in the clearest of weathers and at such high-level stations that their origin cannot be attributed to anything other than molecular scattering. Gruner has, indeed, shown that the observed changes of colour of skylight when the sun is near the horizon can be explained by scattering by a pure atmosphere.

The writer has recently calculated the intensities of sky illumination due to molecular scattering when the sun is on the horizon at a place 2 km. above sea-level for the wave-lengths 0·45 μ, 0·55 μ, and 0·65 μ by a method somewhat different from that of Gruner, and as some of the results obtained are new, they may be of general interest. The light from the sky when the sun is on the horizon has a much smaller proportion of the shorter waves than the normal daylight sky. In the zenith, where the relative proportion of the short waves is the largest, the ratio of blue (0·45 μ) to red is only 1·3 while, according to the inverse fourth-power law, it would be 4·3. As we move from the zenith to the horizon, the proportion of blue decreases still more, the ratio becoming 0·48 at a zenith distance of 80° in a direction perpendicular to the sun's rays, and 0·45 at the same zenith distance on the side opposite to the sun. The calculated absolute values of intensity are also of the same order of quantities as the values observed by Dorno at Davos (1·6 km. above sea-level), but there is a tendency for the observed values to be larger in the quadrant of the sky containing the sun.

The way in which different layers of the atmosphere contribute to the illumination is also interesting. The proportions of the total light of wave-lengths 0·45 μ and 0·65 μ coming from different layers of the zenith sky are as follow:

Height.	Wave-length.	
	0·45 μ.	0·65 μ.
2-10 km.	8 per cent	38 per cent.
10-20 ,,	47 ,,	44 ,,
20-30 ,,	33 ,,	15 ,,
30-50 ,,	12 ,,	4 ,,

The single kilometre layers from which the maximum percentages come are 17 to 18 km. for the shorter wave and 9·5 to 10·5 km. for the longer.

In the calculations mentioned above, only primary scattering has been taken into account. But observation shows that complete neglect of self-illumination is not justifiable. For example, even in the clearest weather during the winter months at Simla (1·9 km. above sea-level), when the light from the zenith sky is analysed by a double-image prism and nicol, the weaker component is found to be richer in blue than the stronger, due, no doubt, to the self-illumination being greater for the shorter waves.

The effect of self-illumination may be expected to be a minimum, if confining our attention to the longer

[1] C. Dorno, "Himmelshelligkeit, Himmelspolarisation und Sonnenintensität in Davos, 1911 bis 1918," *Veröffent. des Preussischen Meteor. Instituts, Abhandlungen*, Bd. 6, 1919.

[2] P. Gruner, "Beiträge zur Physik der freien Atmosphäre," Bd. 8, pp. 1 and 120 (1919).

waves, we observe in a direction perpendicular to the sun's rays but at a zenith distance of 70° to 80°, where the absolute intensity of the primarily scattered longer waves is greater and the greater part of the radiation comes from a comparatively thinner layer nearer the surface of the earth. Observations at Simla show that the polarisation for the red in these directions often reaches values so high as 30 per cent., which may be compared with 91·6 per cent., the value of the polarisation of the light transversely scattered by pure air. K. R. RAMANATHAN.

Colaba, Bombay, June 25.

Medical Entomology and the Tropical Field Worker.

WITH a wider enlightenment on matters of public health among all communities, east and west in the tropics and sub-tropics, nowadays the medical officer of health finds a more insistent demand on his attention to problems connected with medical entomology.

Before proceeding to his tropical or sub-tropical appointment the medical officer of health has doubtless had a training in medical entomology, and often has acquired an active interest in this important subject; so much so, that if his destination is to some locality, let us say, where malaria is rife, he takes up his appointment with an enthusiastic intention of improving conditions. To those of us who have seen the arrival of many a medical officer of health in the tropics that is but the beginning of the story. The remainder is less satisfactory, and sadly uniform in most instances: on arrival he can give a fairly excellent account of the systematic divisions of the Anophelini, and a poorer—often a decidedly bad account—of the Culicini, and can readily distinguish an anopheline from a culicine larva (when it is in the laboratory, or microscopically mounted). So he arms himself with a few tubes, and then usually wonders where on earth he can find the species of his locality. At the back of his mind is the recollection that 'old tin-cans, broken bottles, gutters, and water-tanks' have been mentioned as being dangerous mosquito-breeding places, and a search is therefore diligently made in these situations. His efforts are rewarded, maybe, by the capture of what ninety-nine times out of a hundred are culicine larvæ—which he distinguishes by the presence of the siphon. Ere long the capture of 'Culexes' becomes less exciting, and he possibly seeks in the foulest pond in the district for the more interesting anopheline larvæ. By great good luck he may find one or two, and with a feeling of just pride orders the abolition of that breeding-place; while some clearer, but, in reality, more pestilential pond in which he found no larvæ, yet where there are actually thousands, continues to breed its pests.

In the end, supported only by a meagre knowledge of the systematic divisions of the Culicidæ, upon the capture of a few larvæ which all look horribly alike and cannot be identified as anything particular, and perplexed by the unaccountable numbers of mosquitoes which continue to swarm, enthusiasm speedily dies with the feeling that "this mosquito business is a subject only for the expert."

The reason for all this is obvious: we might as well expect to produce competent surgeons by a training devoted to descriptions and the examination of excised pathological exhibits. At present, astonishing as it is, instruction in medical entomology follows an absurdly parallel course: academic teaching and laboratory exhibitions (decidedly essential as they are) are almost the sum total of what instruction in medical entomology constitutes. The bionomics, the remarkable habits of some species, the practical methods of demonstrating the breeding-places in Nature, the varied methods of collection, the practical application of control measures in the field; all these matters of paramount importance in the training and successful work of the sanitarian receive no more attention than can be given in lectures. Consequently, once the sanitarian finds himself in the field, he discovers immediately that for all he has learnt he has no idea how to proceed.

I have merely taken the case of mosquitoes as an example. The same thing is true of the 'field' aspects of all other insect-enemies, and it is indeed time that the essential importance of proper field instruction should be taken into account so as to ensure that the men whom we send out from our schools are not so completely stranded when they meet the problems as Nature herself presents them. To avoid misapprehension, I should perhaps add that the Wellcome Field Laboratory is *not* a teaching centre where such practical instruction as that referred to can be obtained. MALCOLM E. MACGREGOR.

Wellcome Field Laboratory,
Wisley, Surrey.

Accurate Square Roots.

IN NATURE for June 19, Mr. John Wishart directs attention to certain inaccuracies of one unit in the last printed place in Barlow's Tables of the square roots of numbers. Such errors are very common in these tables, applying to approximately ten per cent. of all the square roots; and they also apply, apparently even more frequently, to the cube roots. The reciprocals in the same tables are much more accurate, but even these are occasionally in error by a unit of the last printed place.

Mr. Wishart says that "there are some who have need of all the figures that existing tables give them, who sometimes wish, indeed, that more were available." I gather from this and from other hints in his letter that he may not be acquainted with the very useful collection: Hülsse's edition of Vega's Tables, published by Weidmann at Leipzig, 1840. On pages 476 to 575 are there given the square roots of all integers up to 10,000. They therefore have the same extent as Barlow's Tables but they give the roots to twelve decimals, five more than Barlow. The same table gives cube roots to seven decimals just as Barlow does, but they are carefully rounded off to the correct digit.

The best table of reciprocals is that by Oakes (published by Layton, London), which gives them to seven significant figures for all integers up to 100,000; care was taken to make the last printed digit correct. Hülsse's and Oakes' tables together should replace Barlow's where great accuracy is needed. But Barlow's tables, as Mr. Wishart intimates, are very convenient indeed whenever an error of one part in 100,000,000 is not important, and this is almost always the case.

The following method for deriving or testing square roots to many places may be of interest. Let N be the number the root of which we wish to extract, and let a and b be two nearly equal numbers such that

$$ab = N.$$

We have then

$$\sqrt{N} = \sqrt{ab} = \frac{1}{2}\sqrt{(a+b)^2 - (a-b)^2}$$
$$= \frac{a+b}{2} - \frac{(a-b)^2}{4(a+b)} + \dots$$

If, therefore, b differs from a by one part in 10^7 say, $\frac{1}{2}(a+b)$ will differ from $\sqrt{N}$ by only about one part

in 10^{15}. With an eight-bank computing machine we can readily find values for a and b that do not differ by more than one part in 10^7 and will usually differ by much less than this. Their arithmetical mean will therefore be the square root of N with an error of, at most, one part in 10^{15}. If still more digits are required, eight additional ones can be obtained in a few minutes by computing the term in $(a-b)^2$ above.

The same method can be used to extract square roots to three significant figures by mere inspection, and this degree of accuracy is sufficient in many computations, including solutions by least-squares. Thus, for example, the square root of 8·46 is seen to be not far from 3; dividing by 3 we get 2·82; the mean between this and 3 is 2·91, which differs from the square root of 8·46 by only 0·0014.

FRANK SCHLESINGER.

Yale University Observatory, July 12.

The Polishing of Surfaces.

THE manner in which an optical polish is produced on glass and metal surfaces has been considered by the late Lord Rayleigh (" Polish," Collected Papers, vol. 4, p. 542, " Interference Bands," vol. 4, p. 54). The amorphous layer theory of the late Sir George Beilby is well known. The article by Dr. J. W. French on " The Working of Optical Parts " (" Dictionary of Applied Physics," vol. 4) summarises and extends these considerations. Reference may also be made to a paper by M. M. Fichter, a notice of which appeared in NATURE, August 2, 1924, p. 173.

The object of this present note is to suggest that, in the process of polishing, surface layers are really melted by the communication of heat vibrations to them Consider a single surface layer of glass molecules of area 1 sq. cm. If glass consisted wholly of silica there would be approximately 9×10^{14} molecules per unit area, each of mass 9×10^{-23} gram. Taking the specific heat of glass as 0·16, initial temperature 20° C., melting-point 1100° C., and assuming a latent heat of fusion 100 calories per gram, the heat required to melt a single layer of molecules of 1 sq. cm. area would be 900 ergs.

Now Beilby gives a pressure of 4 lb. per sq. inch (280 grams per sq. cm.) as sufficient to produce surface flow with rouge polishing. Taking a coefficient of 0·3, the work done against friction when this force is overcome through 1 cm. is 83,000 ergs.

As one stroke of a polisher will polish only a small proportion of the 1 sq. cm. area considered, there will be available in the ordinary polishing procedure frictional energy of amount many hundreds of times that required to melt one layer of glass molecules.

At first sight it might be thought that any great rise in the temperature of the surface molecules would be prevented by the loss of heat due to conduction, etc. But this is to suppose that conduction would take place across plane interfaces. Is it not more reasonable to consider the heat as being produced at *points* of contact? If these were mathematical points, then no matter how small the rate of production of heat at a point, the temperature at the point would be infinite (the expression for the steady temperature v at distance r from a point in an infinite solid where heat is being supplied at the rate of q calories per sec., is $v=q/4\pi rk$, where k is the thermal conductivity of the material).

That the temperature attained by a surface depends essentially on the manner in which the heat is applied, is illustrated by the fact that a bunsen flame (of high temperature) may be played on a block tin surface without melting it, while a small globule of molten lead (only 100° C. above the melting-point of tin), if dropped on to a tin surface, will melt the tin below.

As an analogy to the manner in which high temperature vibrations may be set up locally, in polishing a surface, reference may be made to the setting of a Kundt's tube into vibration by slowly stroking it by hand, or a violin string by the slow stroke of the bow.

JAMES M. MACAULAY.

Natural Philosophy Dept.,
The Royal Technical College,
Glasgow, C.1, August 4.

The Planetismal Hypothesis.

As there is a rising tide adverse to the planetismal hypothesis, may I record the following observation in its favour? Looking at the moon with a 9½-inch reflector, I saw details of the structure of the great south wall of the crater Hommel; the circular fault is perfectly fresh, and the rock exposed is a giant conglomerate, the boulders several hundred yards in diameter, with cavernous spaces between. In moments of perfect pellucidity, my instrument is quite capable of defining objects half a mile in diameter. My observation confirms Pickering's at Arequipa, when he was looking at the fault-scarp of the Sinus Iridium, in the opposite quadrant.

On the earth, iron is being taken from the surface rocks by weathering; it is washed down in solution into the rivers, but does not reach the sea. It goes downwards, and where there is a precipitant, it replaces limestone, forming deposits of iron-ore; where there is nothing to stop it, it must proceed towards the centre of the earth. Reversing the process, it follows that this iron would have made the crust of the earth an ultra-basic material in the early history of our planet, or in other words, it would have been similar to what we now find on the moon, where there has been no water to obscure matters. The lower specific gravity of the moon would be accounted for by the boulders making an arch and girder formation, with spaces between.

E. H. L. SCHWARZ.

Rhodes University College,
Grahamstown, July 9.

Zoological Nomenclature: Suspension of *Sarcoptes*, type *passerinus*, in favour of *Sarcoptes*, type *scabiei*.

THE secretary of the International Commission on Zoological Nomenclature has the honour to invite attention of the zoological profession to the fact that application has been made to the Commission to suspend the rules in the case of *Sarcoptes* Latr., 1804, tsd. (Latr., 1810) *passerinus*, and to place *Sarcoptes*, 1804, in the Official List of Generic Names with *S. scabiei* as type.

The argument states that the application of the rules to this 'transfer' case will result in greater confusion than uniformity, involving generic, subfamily, and family names, and designations of diseases in human and comparative medicine. The suspension requested will result in validating internationally accepted (though erroneous) nomenclature in consistent use for more than a century in zoology, and in human and comparative medicine.

The secretary is familiar with the premises, and in his report to the Commission will state that he considers this a typical case in which suspension is justified. He will, however, delay announcement of final vote until about October 1, 1927, in order to give ample opportunity to interested persons to express their views for or against the suspension.

C. W. STILES,
Secretary to Commission.

Hygienic Laboratory, Washington, D.C.,
August 3.

The Optical Works of Sir Howard Grubb, Parsons and Company.

A FEW years ago it was very difficult to obtain a large object glass for an astronomical telescope. The optician would only promise a glass conditionally on his being able to procure suitable discs. For example, the director of the Johannesburg Observatory placed a contract for a 26-inch refractor in 1909, and four years later, in 1913, he reported that "it is hoped that glass discs will be obtained shortly." Large discs of optical glass are required only rarely, and their manufacture is a delicate operation requiring special plant; consequently very few people make them.

FIG. 1.—Erecting bay showing sliding roof partly open.

British astronomers were greatly pleased when the manufacture of large discs of optical glass was taken up by Sir Charles Parsons, who acquired the business of the Derby Crown Glass Works from Messrs. Wood Brothers, in 1921. Sir Charles Parsons has an hereditary interest in astronomy and the manufacture of large astronomical telescopes, as his father, the Earl of Rosse, built the famous six-foot reflecting telescope at Birr Castle, Parsonstown, King's County, Ireland. This early interest doubtless influenced him in taking up the manufacture of astronomical instruments from beginning to end—the manufacture of glass, the grinding and figuring of lenses and mirrors and the mechanical parts of telescopes. Near the beginning of 1925 he acquired the old-established business of Sir Howard Grubb. This famous firm was founded by Thomas Grubb a hundred years ago, and developed by the optical and mechanical skill of Sir Howard Grubb, under whose direction many fine telescopes, refractors, and reflectors have been produced. In 1918 the works were moved from Dublin to St. Albans in connexion with the manufacture of periscopes for the Navy, instruments which have been a standard product of the firm since the date of the first British submarine.

New works were set up in 1926 at Walker Gate, Newcastle, in close proximity to the well-known works of Messrs. C. A. Parsons and Co., Ltd., makers of steam turbines, electrical machinery, and searchlight mirrors. Close association with large engineering works is a great asset for makers of astronomical instruments. For small telescopes comparatively small plant is required, but for large ones the resources of engineering works with machines of the necessary size and accuracy are essential. In such accessories as large domes and rising floors, which are necessary with big instruments, large machinery is also required. For all heavy machine work the large machine shops of the Heaton works of Messrs. C. A. Parsons and Co. will be used. Nor must the great advantage be overlooked of the interchange of ideas among the staff, made possible by close association with the larger world of engineering.

An internal view of the principal bay of the new optical works is shown in Fig. 1. An important feature of this building is the provision for sliding off a large portion of the glass roof by carrying it on a supporting gantry moved by electrically operated motors. The shop possesses a five-ton electric travelling crane; one end of the bay is fitted up as a machine and fitting shop, and the other is used for the erection of instruments. Means of testing large instruments in course of construction by actual observation of

FIG. 2.—Insulated tunnel for the horizontal testing of mirrors and objectives.

stars are thus provided. Generally this is a matter of difficulty at optical works, but however well the laboratory tests may be satisfied, the purchaser of a telescope, as well as the maker, wishes to see how the instrument performs the end for which it is intended, before it is taken away from the works and erected in a possibly distant observatory.

In the transfer of the optical works from St. Albans to Newcastle the essential personnel as regards both staff and workmen was retained. One establishment is in complete continuity with the other, and it may well be that some of the improvements in the fitting up have been suggested by the previous long experience of the firm of Sir Howard Grubb. The means for testing large mirrors and objectives in the course of construction have been carefully planned. While in position on the polishing machine they can be conveyed by an electrical lift to the bottom of a shaft belonging to the optical testing room. Much labour and time is thus saved in the course of polishing a large mirror or objective which will be tested many times. Fig. 2 shows the horizontal testing tunnel. This is 100 feet in length, and gives the means of testing mirrors and objectives in a room of constant temperatures and free from disturbing effects of air currents. The rough polishing shop is shown in Fig. 3.

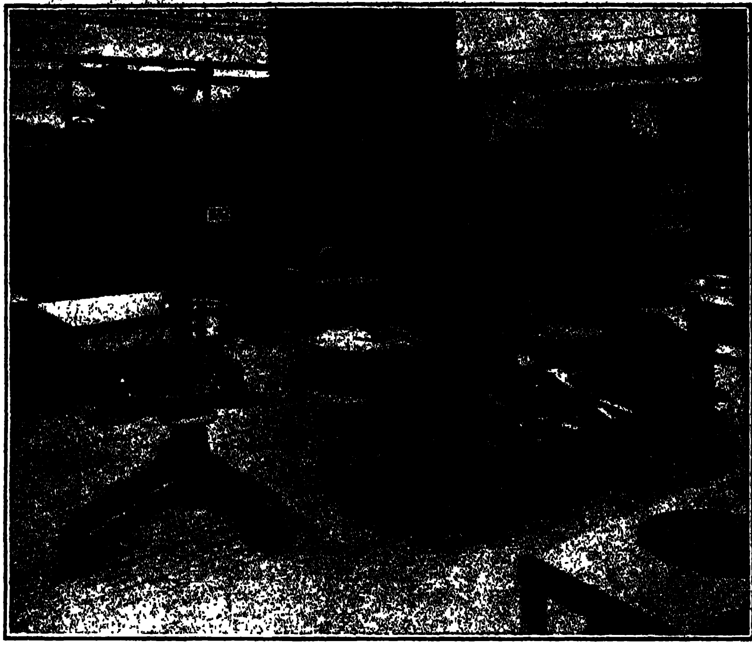

FIG. 3.—Optical roughing shop.

Among the instruments already constructed by the firm are a seven-metre solar spectrograph for the Pulkovo Observatory and a 40-inch reflecting telescope for the Observatory of Simeis in Southern Russia. In the annual report of the Observatory, published in the *Vierteljahrschrift*, and quoted in NATURE of July 17, p. 97, an account is given of the mounting and testing of the mirror. The departure of the mirror from paraboloidal state is found to be of the order of one-tenth of a wave-length, showing the mirror to be of very perfect figure. A description of the telescope, and of its mounting and control, was given in NATURE of April 12, 1924.

FIG. 4.—Optical discs for 41-in. objective.
These discs were manufactured by The Parsons Optical Glass Company at Derby.

At the present time, Sir Howard Grubb, Parsons and Co. are engaged on the ambitious task of constructing a refracting telescope with an object glass of 41 inches diameter. When completed, this telescope, which is also intended for the Simeis Observatory, will have a slightly larger aperture than that of the Yerkes Observatory. The focal length will, however, not be so long, as the instrument is designed for photographic rather than visual work. The discs have already been made at the Crown Derby works, and Fig. 4 shows them in the optical testing shop in Newcastle. Some time ago it was reported by a news agency that the discs had failed to satisfy the optical tests specified, but, as was announced in NATURE of June 19, p. 868, the statement was entirely erroneous. The progress of this large telescope will be watched with great interest and in confidence that a very fine instrument will be

The Mechanics of the Electric Field.[1]

By Sir J. J. THOMSON, O.M., F.R.S.

THE subject which I have selected for the Kelvin Lecture is one that from the very beginning of his scientific career was never long absent from Lord Kelvin's thoughts. It is one, too, which researches only dawning towards the close of his life have put into quite a new aspect. These researches have given us very definite information as to the structure of the atom; they have taught us that the atom is made up of electrons and positively electrified particles of known masses; they have told us the number of electrons and positive particles present in each atom; they have, in fact, given us a definite specification of the electrical state of the atom. With this in our possession it would seem as if we ought to be able to deduce the properties of the atom, by calculating by means of the laws of electromagnetism the behaviour of this definite electrical system. We find, however, if we do this, that the properties of our mathematical atom are in some respects in contradiction to those of the real atom. It is of course a gigantic extrapolation to pass from any system which we can test by direct experiment, and for which the laws of electromagnetism have been verified, to systems like the atoms, where the times and distances involved are of an entirely different order of magnitude. The extrapolation fails, but the point is that if the usual interpretation of these laws is the right one it ought not to fail.

I propose to discuss the question whether the equations of classical electrodynamics or, for the matter of that, classical dynamics are as fundamental as they have been thought to be; whether, instead of giving us a complete representation of the field of force, they do no more than give us the relations between the average value of the quantities used to define the field. That, in fact, they express statistical and not particle dynamics.

Let us consider some of the consequences of supposing that electric force consists of separate impulses separated by finite times. I must point out that this conception involves the existence in the universe of a structure beyond that represented by electrons and positive particles; if there were no structure of this kind, we could not account for the intervals which elapse between the impulses. This structure must be far finer in texture than the electrons; thus, on this view, the electron does not represent the last word in minuteness and there are still smaller entities awaiting discovery by the physicists.

For heuristic purposes, *i.e.* for the purpose of making our meaning clear, and without committing ourselves to the reality of this particular structure, we may liken it to a sub-atomic and sub-electronic gas the particles of which are much finer than the electrons. It is in these particles that the energy and momentum of the electric field are stored. We may regard these particles as concentrated round the electric charges, each charge carrying with it an atmosphere of these particles. The particles are crowded together near the centre of the charge, but get more and more widely separated as the distance from the centre increases. To distinguish between the positive and negative charges, we may suppose that the particles rotate round the charges and that the rotation as viewed from the centre of the charge is in one direction for the positive and in the opposite direction for the negative charge.

The particles bombard intermittently the charges round which they are congregated. If there were only one charge in the field the particles would be symmetrically distributed around it and the bombardment would not, on the average, make it move in one direction rather than in another; but when two or more charges are near together the symmetry of the distribution of the particles is disturbed and the bombardment results in the charges acquiring momentum.

Let us now consider in some detail the way in which the effects produced by intermittent forces differ from those due to continuous ones. We may represent the intermittent force analytically by saying that the chance of a body on which this force is acting receiving in time δt an increment of momentum is $\delta t/D$, where T is the average time between two increments and is a measure of the fineness of the time structure of the electric field. Let I be the increment of momentum given at each impact; then the expectation of the increase in momentum in time δt is $(I/T)\delta t$. If the force had been continuous and equal to F, the increase in momentum would have been equal to $F\delta t$ and have had a definite value. On the intermittent view, instead of a certainty we have an expectation: sometimes the results will exceed expectations, sometimes they will fall below them; but on the average, when there are a great many increments, *i.e.* when δt is large compared with T, they will differ but little from the expectation, so that the increase of momentum will be $(I/T)\delta t$, or the same as the body would receive from a continuous force $F = I/T$. Thus for effects lasting for times long compared with T, the results will be very nearly the same whether the forces are continuous or discontinuous; but for shorter times they will be very different.

We may illustrate the difference between a continuous and an intermittent force by considering a simple case. Take that of an electron projected horizontally and exposed to the influence of a vertical force for a time t. Whether the force be continuous or intermittent the horizontal velocity will remain constant and the horizontal distance travelled is not affected by the intermittence of the force. When the force is continuous and constant there is only one orbit, the parabola. If the force is intermittent there will be an infinite numb of possible orbits. In fact any polygon is a possible orbit, provided the rth side makes an angle with the horizontal such that tan $\theta r = kr$, where k is a constant. Thus a horizontal straight line is a possible orbit, because there is just a chance that the electron may escape a collision for the time t.

There is an infinite number of two-sided orbits where the electron makes one collision in the time t. At the end of these orbits all the electrons have the same kinetic energy, but they will not all have suffered the same vertical fall, *i.e.* they will not all have the same potential energy; this is an illustration that the

[1] From the Seventeenth Kelvin Lecture, delivered before the Institution of Electrical Engineers on April 22.

conservation of energy in the ordinary sense does not hold for these intermittent forces. To get the same increase in kinetic energy as they would under the action of a continuous force, some of the electrons under the intermittent force would have lost less, others more, "potential energy" than they would under the continuous force.

Again, there is an infinite number of 3-, 4-, 5-sided orbits; there is no limit to the number of sides, and the greater the number of sides the greater the kinetic nergy acquired by the electron describing the orbit. ll these are possible orbits, but some of them are very probable. We can calculate the probability of any of orbit. We have already seen that the most bable number of sides for the orbit is t/T; this m kes the final momentum have the same value and dir tion as it would under the continuous force. But the number of sides is given, the individual side y have very different lengths. We can show that most probable orbits are those where the impad are equally spaced over the journey. Again, the m probable orbit is the one that approximates most ly to that described under a continuous force. is, however, only when t/T is a very large number that the chance of orbits departing widely from this becomes inconsiderable.

I have already pointed out that the principle of the conservation of energy in its usual form does not apply when the forces are discontinuous. This is because the energy is stored in the particles which constitute the electric field, and the distribution of these particles and their energy may change, even though the electrons and positive particles do not move: an electron may take energy from these particles or give up energy to them without suffering any change in its potential energy.

Take, for example, the case of an electron starting from an infinite distance from a positive particle, falling close to the particle and then receding from it until it is again at an infinite distance away. The potential energy is the same at the beginning and end, so that if the principle of the conservation of energy holds, the kinetic energy at the end must also be the same as at the beginning. If we suppose that the mass of the positive particle is infinite compared with that of the electron, so that it absorbs no kinetic energy, the velocity of the electron at the end of the journey must be the same as that at the beginning.

This need not, however, be the case if the force is discontinuous, for when the electron is falling from aphelion to perihelion the increase in its kinetic energy depends upon the number of increments of momentum it receives during its journey from aphelion, and when it goes away from perihelion to aphelion its loss of energy depends upon the number of increments of momentum it receives on the return journey. Now, according to the intermittent theory of the force, these numbers are not fixed but are a matter of chance, so that there is a finite probability that the electron on its journey from aphelion to perihelion may receive more than a normal number of increments, whilst on the return journey it would receive less. If this were so, the electron would receive more energy in its approach than it would lose on its return, so that it would have gained by the journey kinetic energy without losing potential.

The chance of losing more energy on its return than it gained on the approach is just as great as in the case we have considered, so that some electrons may lose kinetic energy by the journey without gaining potential energy. The fact that it is possible for an electron to gain energy in this way has, I think, an important application to the question of the spontaneous dissociation of atomic systems.

Let us take the case of an electron describing an elongated orbit about a positive centre, and suppose that in going from aphelion to perihelion it receives more than the normal number of increments of momentum; when it gets to perihelion it will have more than the normal amount of kinetic energy. Suppose that the increments in the return journey are not more than normal, then on reaching aphelion again the electron will have more kinetic energy than when it started. If this increase in energy exceeds a certain amount, *i.e.* if it is so great that when the electron approaches the place from which it started it has sufficient energy to carry it against the attraction of the positive centre from this place to an infinite distance, the electron will break away and separate from the positive centre.

In this way the discontinuous character of the force may give rise to a spontaneous dissociation of the system—spontaneous in the sense that it is a consequence of the character of the forces acting between the members of the system, and does not depend upon collisions with other molecules or electrons or on the influence of radiation.

An example of this spontaneous dissociation is afforded by the negative ions in gases; these have two phases, one being the electron, the other a complex of the electron and one or more molecules. The first phase is continually passing into the second by the combination of electrons with molecules, and the second into the first by the dissociation of the complex. The rate of this dissociation is independent of the pressure of the gas, and there is no evidence that it is affected by radiation. Similar considerations show that when the force is intermittent an electron moving past a positively electrified particle may acquire or lose energy by the collision, even though the mass of the particle is infinitely greater than that of an electron, when if the force were continuous there would be no transference of energy to or from the electron. Thus it might be possible for an electron projected with less than the energy required to ionise a gas to acquire by collisions with positive particles enough energy for this purpose.

Let us now consider more in detail other characteristics due to the intermittence of the electric force; these will naturally occur only when the phenomena involve times short enough to be comparable with the time interval of the electric field. This time interval, we may say in passing, is not constant but varies with the strength of the electric field, diminishing as the strength of the field increases. Now suppose the electric field acts on an element of volume which contains a very large number of systems, be they electrons, atoms, or anything else which can be effected by electric force; and suppose the time t the force acts is small compared with T the time interval of the force. We can easily show that the momentum received by

the whole system will be the same as if the force had been continuous and equal to I/T. This will be true whatever the time may be during which the force acts. The distribution of momentum will, however, be very different in the two cases, when the time of action is small compared with T.

The difference between the continuous and the intermittent force is accentuated when the forces are reversed after short intervals. If the field is intermittent and t is small compared with T, only a small fraction of the systems will have received any energy. When the field is reversed, the chance that any of the few systems previously excited will receive negative momentum and so lose energy is exceedingly small, and the great majority of systems which receive energy in the second interval will not have received any in the first. Thus the systems absorb practically as much energy from the electric field in the second interval as they did in the first. Under the continuous field, instead of absorbing energy, in the second period they gave up all they had got in the first.

Thus the intermittence of the field may lead to a great increase in the absorption of energy from alternating fields by systems exposed to the action of the field. The question of the transmission of waves of electric force when the period of the wave is shorter than the time interval of the electric force, is therefore one that introduces considerations quite different from those of electrical waves of longer period, and requires special treatment.

In the first place, the equations of the electric field do not, if we take the view of the intermittence of force, represent relations between physical quantities which have an existence at any particular time; they have respect rather to the relations between certain statistical quantities, averages taken over a time which is long compared with the time interval of the electric field; for these equations represent relations between electric and magnetic forces. From the point of view of the intermittent theory, electric and magnetic forces do not represent anything that is happening at any particular instant, but an average taken over a time which is long compared with the time interval of the electric field. Thus these equations are meaningless when the times available are not long enough to allow this average to have a definite value. They would not apply, for example, to the case of electrical waves if the period of the waves were less than the time interval of the electric field.

The consideration of what would happen to electrical oscillations the period of which is shorter than the time interval of the electric field, is a matter of great interest and importance. The time interval T of the electric force is connected with F, the intensity of the force by the relation $F=I/T$, where I is the momentum communicated at each impulse, so that as the intensity of the electric field diminishes I/T diminishes also. Now, whatever view we may take of the origin of the impulses which produce the force, whether, for example, we regard them as due to collisions with a swarm of very minute particles or in any other way, we should expect the interval between the collisions to increase as the field gets weaker. The time interval would be a function of the intensity of the field and would be longer for weak fields than for strong. Now consider an electron oscillating with a definite period T_0. Close to the electrons the electric field may be very intense, and its time interval may be short compared with T_0, the period of the oscillations. In such a region as this the classical theory would apply and electrical waves would travel through it, starting from the source of the oscillations. But as the distance from the source increases, the electrical field gets weaker and the time interval continually increases until when a certain distance is reached the time interval becomes comparable with T_0. When this region is reached it seems clear that the waves must stop, as Maxwell's equations from which the wave motion is deduced do not hold.

We have seen too that when T_0, the interval between the reversals of the electric force, is small enough to be comparable with the time interval, the absorption of the energy of the electric field is far greater than when T_0 is long compared with the time interval. We should not therefore expect these waves to travel farther away from the source than the place where the time interval of the electric field is equal to the period of the oscillations. For oscillations of very long period the critical place would be one where the time interval is long, *i.e.* where the field is very weak, and thus may be at a very great distance from the source; whilst for oscillations of very short period the critical place would be one where the time interval is short, *i.e.* where the force is very intense, and thus, *ceteris paribus*, much closer to the source of oscillations than for the slow vibrations.

As an illustration we may take one often used by Lord Kelvin. This is the case of a tightly stretched long string loaded at equal intervals with equal masses. This system has many periods. If P is the fastest of these, $P=\pi\sqrt{(lm/T)}$, where T is the tension in the string, m the mass of one of the particles loading the string, and l the distance between two adjacent particles. If one end of the string is agitated harmonically with a period p, waves will travel freely along the stretched string as long as P is less than p. If, however, the string is made more sluggish by increasing the mass of the particles or otherwise, so that p becomes less than P, the string will no longer transmit the waves, and the energy, instead of travelling along the string, will be localised close to the extremity which is agitated. The model would resemble the electrical case more closely if, instead of spacing the particles at equal intervals, the distance between two adjacent particles increased with the distance from one end A of the string; the value of P would increase with the distance from this end. If the end A were agitated harmonically with a period greater than the value of P close to A, but less than the value of P at some distance from A, the waves would travel along the string until they reached the place where P was equal to the period of agitation. Here they would be reflected back and the farther parts of the string would be free from agitation.

To return to the case of the vibrating electron; we see that though it may send out electrical waves, these waves, after travelling through a distance which depends on the period of the vibrations and also upon their amplitude, will reach a region through which they cannot penetrate, and will be reflected back. Thus the energy emitted by the radiator will not travel out

into space but will be reflected back and again absorbed by the radiator, and thus there will be no escape of energy.

If the oscillations were due to an electron describing a circular orbit, the reflected waves when they struck the electron and gave up their energy to it would, in general, deflect it and cause it to describe a different orbit. Thus the motion of the electron would not be steady. There may, however, be some orbits where the distance of the boundary at which the reflection takes place from the orbit is such that the reflected waves are in such a phase when they reach the electron that they just compensate for the changes in the motion of the electron produced by the emission of the radiation. For such orbits the uniform circular motion might be a steady state. It is evident that certain conditions have to be fulfilled for this to happen, so that it is only orbits with particular periods which possess this property. Since the application of a strong electric force would diminish the time-constant of the field, these orbits would be displaced by electric force. We may illustrate this point by the case of a piston vibrating at one end of an organ pipe which is closed at the other. In general, the waves reflected from the closed end will influence the motion of the piston, but they will not do so if the period of the piston is such that a loop of the vibrations of the pipe coincides with the position of the piston.

Let us apply similar considerations to light waves. Assuming that light is an electrical effect, we see at once that there can be no unlimited propagation of spherical electrical waves diverging from a source such as is contemplated in the usual conception of the electromagnetic theory of light; for on this view energy in the light is distributed continuously through space, and the energy per unit volume diminishes indefinitely as the light travels farther and farther away from the source. Now we have seen that the condition for the propagation of a periodic disturbance is that the period of the disturbance should be greater than the time interval of the electric field; this interval increases, however, as the energy in the light diminishes, so that when the energy falls below a certain value, which is small for long-period vibrations and large for short-period ones, any further propagation is impossible. Thus the intermittence of electrical force demands a corpuscular theory of light, *i.e.* a theory where the energy is done up in bundles which do not alter in size as they travel through space. The bundle may consist of a periodic distribution of electric force, like a piece cut out of what on the classical theory represents a beam of light. This piece is prevented from spreading because the energy density at its boundary has the critical value, and this boundary acts, on our view, like a reflecting surface and sends back any disturbance which tries to get outside it.

I picture these units as consisting of two parts: a central core in the form of an anchor ring, the plane of the ring being at right angles to the direction in which the unit is travelling. This ring is the seat of an intense electric field, and the circumference of the ring is equal to the wave-length of the light. This ring corresponds to the quantum of the light. This ring vibrates and emits electrical waves which, after travelling to a certain distance from the centre, get to the limit where the time interval of their electric field is equal to the period of the light. This forms the boundary of the unit, and the space occupied by the waves and the energy in them remain unaltered as the unit travels through space. On this view, light has a dual structure consisting of electrical waves with a quantum as the core. The electrical waves give rise to interference effects, the quanta to the photo-electric ones.

On the view that the force is intermittent the electric field must have a structure, and as electrons and positive particles are the centres of intense electric fields, they are probably much more complex than the usual conception of them, and must be regarded as centres of complex systems associated with an electron or a positive particle. If we compare the atom with its electrons to a solar system, we may compare an electron or a positive particle to the centre of a nebula and regard the electron as surrounded by an atmosphere of small particles.

This atmosphere can be distorted by the presence in its neighbourhood of other electrons or positive particles with their atmospheres, and will assume a shape appropriate to its surroundings. Thus the atmosphere round an electron far from other charges would be symmetrical and, if it were distorted, would vibrate about the symmetrical shape. Thus we could have vibrations associated with single electrons or single positively charged particles, even though the electron or particle were itself at rest; for example, without becoming neutralised by the absorption of an electron, a positively electrified hydrogen atom might be able to give out radiation. The possibility of vibrations of an electric field apart from any movement of the charges in the field has not, I think, been sufficiently realised.

These considerations suggest that just as matter is made up of molecules, and molecules are made up of electrons and positive particles, this is not the end of the story; there are still other worlds to conquer, the worlds which build up the electrons and positive particles.

Coal Ash and Clean Coal.[1]

IT is the normal view that the incombustible par of coal is not only a useless but even objectionabl diluent. At times in the past, chemists, familiar wit the theory of contact catalysis of gas reactions, hav speculated that the ash constituents might well pla an active rôle in the processes of carbonisation an combustion. None have been more prominent thai Dr. Lessing, but his opinions met with no great support The reactions in question seemed too complex, and n experimental confirmation had been adduced. Evei Dr. Lessing himself waited until 1924 before disclosin evidence that inorganic substances altered the cours of carbonisation. Since then, however, the subjec has aroused greater interest. It is possible now fo

[1] Cantor Lectures by Dr. R. Lessing before the Royal Society of Art Nov. 23, 30, and Dec. 7, 1925.

Dr. Lessing's ideas to receive independent support. Processes have even been patented for modifying the results of coal carbonisation by means of control of the ash constituents.

In the Fuel Department of the University of Leeds, where the process of gasification of coal has been under experimental study for some years, it was soon observed that the inorganic constituents could not be ignored. They might be incombustible but were not necessarily inert. It was the availability in the West Yorkshire area of seams of coal almost free from ash which made it possible, by the controlled addition of inorganic matter, to investigate the influence of individual compounds on carbonisation. The results exceeded expectations, and it was shown by C. B. Marson and J. W. Cobb that the character of the coke produced was beneficially and extensively modified by the addition of certain substances, especially oxide of iron and sodium carbonate. Certain other oxides examined were apparently inert. Since the publication last year of this paper, further experience has only strengthened their conclusions. There is good ground for hope that a valuable control over the carbonisation process may be secured by means of the ash constituents. Indeed, it is no exaggeration to say that there is to-day no prospect in the distillation of coal more alluring than that offered by this method. Obviously, then, the subject is of great practical interest, especially in connexion with the production of smokeless fuel. It may well be that too much attention has been paid to the possibilities of varying temperatures of carbonisation, and too little to the variation of the character and quantity of the incombustible constituents. This oversight is, however, in the way of being remedied.

It is, however, a condition precedent to the most effective use of this new method of control, that the raw material, coal, shall be adequately clean to begin with. Any coke or smokeless fuel product will have to compete for popular favour with good household coal, which may in the best cases be even so low in ash as 2 per cent. It is, unfortunately for those who set out to provide smokeless fuel, only too true that the housewife is apt to think more of dirt on the hearth than of smoke leaving the chimney-pot. If the carbonised product is to contain added inorganic matter, as well as the ash originally present, it is obviously essential that the raw coal must be very clean, for the ash content of the coke produced from it will necessarily be higher. Nothing is more important to the popularisation of smokeless fuel than the supply of clean coal. The stigma which rests on coke as a fuel is largely due to a reputation for 'dirtiness,' and the smokeless fuel problem can never be regarded as solved until a product is obtained which will find favour in the drawing-room of the most fastidious householder.

It is, however, essentially a problem for the mining industry, and its solution would give a powerful fillip to the popularisation of carbonised fuel for domestic purposes. The problem implies the identification of seams of coal which lends itself to cleaning, the improvement of cleaning technique, and the installation of plant necessary to turn out a fuel of the desired standard. The consumer would have to pay more for the product, but it would be necessary and possible to demonstrate that he was not a loser. Time, study, and capital would be required to carry these ideas into effect. It is then the more depressing to see the mining industry dissipating energy and resources of all kinds in a barren struggle instead of wrestling with its own more fruitful problems.

Dr. Lessing believes that these objects will be attained, that the carbonising industries "will feel constrained to insist for their raw material on coal containing only a fraction of the proportion of mineral matter which is customary to-day," and "that the provision of such a commodity will be technically possible and commercially profitable, and that it will be of economic advantage both to supplier and user."

The three lectures are, however, not confined to the importance of ash to coal carbonisation. They also traverse the chemistry of coal ash and its origin, the technique of coal cleaning, the economic aspects, and present a valuable survey of the whole subject.

H. J. HODSMAN.

Obituary.

DR. C. W. ELIOT.

AT a luncheon recently given by King's College, London, for the delegates to the Congress of the Universities of the Empire, Principal Barker introduced President Lowell as "the most distinguished permanent academic officer in the English-speaking world." The phrase was happily taken, and its substantive truth dates from Charles William Eliot, whose death on August 22, fuller of honours even than of years, removes the last survivor of the three captains who bridged the incredible gap between the primal 'college' and the contemporary university; the others were Angell (Michigan) and Gilman (Johns Hopkins). They mediated a change wherein sober fact nigh outruns imaginative fiction. Eliot, the most conspicuous, foresaw the unbelievable, and it came true.

Circumstances must conspire with men to produce significant results. Accordingly, Eliot was fortunately born (1834) from the soundest New England stock, and educated at the best New England institutions. After graduation at Harvard in 1853 he taught mathematics and chemistry in the College and the Medical School for a decade; resided two years in Europe (1863–65), observing the universities shrewdly; returned to occupy the chair of chemistry in the Massachusetts Institute of Technology, where he pioneered for four years. In 1869, after keen opposition, still the subject of piquant legend, he was elected president of Harvard, and launched upon a unique incumbency of forty years. He found the College (1636) with Medical (1782), Divinity (1816), and Law (1817) Schools of a narrow type; he left the foremost American university with a transformed College and a score of other departments.

As the Harvard inscription bears, the New England College was founded "to advance learning and perpetuate it to posterity, dreading to leave an illiterate ministry to the churches"; or, as the Yale charter runs, "fitting youth for public employment, both in church and civil society." In other words, vocation, and one vocation mainly, took precedence over the

advancement of knowledge. Moreover, although Agassiz used a Charles River shed for a laboratory so early as 1848, acquaintance with the natural sciences was usually confined to little physics and less astronomy. Further, the human sciences, as now understood, enjoyed no independent recognition. While striking persons were to be found on the staffs, they were seldom specialists—Mark Hopkins (Williams) taught all subjects to all undergraduates in their final year! Modifying the clerical and bellelettrist tradition, Eliot, though but thirty-five years of age, set himself to create a new order; in addition, he proceeded to reform the meagre curricula and otiose methods of the professional schools. He agreed with his brilliant colleague Barrett Wendell that "the use of heresy is to vitalise creed." Inevitably, he drew much fire; a rare combination of courage, candour, penetration, patience, above all, aplomb, enabled him to make very rough places plain. Under his leadership Harvard rose to unchallenged primacy in twenty-five years, and the example of her chief began to affect academic policies from coast to coast. Blunders were perpetrated in his name and, being human, he added his personal quota. But in sum and substance he won universal recognition as a national asset.

Eliot's remarkable dignity of address and statement came to him by right of heritage. Democratic puritanism, bred of self-understanding, flowered in a peculiar aristocracy, secure in appeal to sense of duty. Eliot was its most conspicuous example. For, elevated far above sordid affairs, his qualities were means to spiritual ends; thus he could confront the American people as a vocal public conscience. He said his say with none to gainsay on grounds of petty interest. He blandly exposed illusions and dangerous symptoms, protesting against the mediocrity of efficient technique as a peril incident to universal education; telling his countrymen that, after all, they must apply for guidance to the select minority who know; insisting upon the equality of every subject open to sober investigation.

Hence, although the United States had passed to another phase during the period of his retirement, he could still speak forthright to the very end. He contributed to science in particular by affording ample facility and genial stimulus to inquiry. His was an exceptional life, because he rose greatly to a great opportunity. Attempting to sum it in a phrase, one might perhaps venture to say that he furnished a striking illustration of that peculiarity of American culture which most baffles other nations—"the parts are greater than the whole." R. M. WENLEY.

MR. W. FAWCETT.

WILLIAM FAWCETT, who died suddenly at his residence at Blackheath on August 14, in his seventy-sixth year, was originally a schoolmaster and graduated B.Sc. at the University of London. In 1880 he was appointed assistant in the Botanical Department of the British Museum, shortly before the collections were transferred to South Kensington. In 1881 he became a fellow of the Linnean Society, from which he withdrew in 1915, but rejoined in 1923.

On December 29, 1886, Mr. Fawcett sailed to take up his appointment as director of Public Gardens and Plantations, Jamaica, a post he retained after the amalgamation in 1903 of the Botanical Department with the Department of Agriculture until his retirement in March 1908. He edited the *Bulletin of the Botanical Department*, Jamaica, from April 1887 until 1902, and the *Bulletin of the Department of Agriculture* from 1903 until his departure in March 1908, when a new series of the latter was commenced by the Hon. H. H. Cousins, the present director. A note on this department was published in the *Kew Bulletin*, 1906, p. 68. In addition to notes in these journals, he published in 1893 "A Provisional List of the Indigenous and Naturalised Flowering Plants of Jamaica," and in the same year "An Index to Economic Products of the Vegetable Kingdom in Jamaica." He also delivered lectures, one of which, an "Introduction to the Classification of Plants," was published at Kingston in 1889. "Historical Notes on Economic Plants in Jamaica" appeared in vol. 6 of the *Bulletin of the Department of Agriculture*, and dealt largely with cigar and tobacco production. After returning to England he commenced, in collaboration with Dr. A. B. Rendle, a flora of Jamaica, the first volume of which, on Orchidaceæ, including text-figures, was published in 1910, and vol. 5 in July 1926; vol. 2 has yet to appear. Most of the work for this was done at the British Museum, but Mr. Fawcett frequently visited Kew to consult the collections there, his last visit being so recent as July 29 last.

As the titles of some of the above-mentioned papers show, Mr. Fawcett was keen on developing the applied side of botany, and in 1913 published a book entitled "The Banana: Its Cultivation, Distribution and Commercial Uses." During his residence in Jamaica he rendered valuable service in developing the vegetable resources of the island, in association with Sir Daniel Morris, the commissioner of the Imperial Agricultural Department of the British West Indies, after the threatened failure of the sugar crop. To Mr. Fawcett was also due the inception of the Imperial Exhibition in Jamaica in 1891. C. H. W.

WE regret to announce the following deaths:

Dr. J. George Adami, F.R.S., Vice-Chancellor of the University of Liverpool, on August 29, at sixty-four years of age.

Dr. R. D. Carman, president of the American Roentgen Ray Society and chief of the section of radiology of the Mayo Clinic, known for his work on the radiology of the digestive tract, on June 17, aged fifty-one years.

Mr. Charles A. Coffin, founder and former president of the General Electric Company, who was responsible for the organisation of the research laboratory at Schenectady, on July 14, aged eighty-one years.

Dr. Willis T. Lee, sometime professor of geology and biology in the University of Denver, and geologist since 1902 of the United States Geological Survey, who studied the stratigraphy of the south-western States with particular reference to ground water and coal investigations, on June 17, aged sixty-one years.

Mr. Frank M. Woodruff, for many years curator of the Academy of Sciences and Museum of Natural History in Lincoln Park, Chicago, and secretary of the ornithological section of the Chicago Academy of Sciences, on July 21, aged fifty-nine years.

News and Views.

THE German Dye Trust, the actual title of which is the Interessengemeinschaft Farbenindustrie Aktiengesellschaft, has long been in the limelight as the largest and most powerful combination of its kind. Only last year its constituent companies entered into a form of union that is indistinguishable from an amalgamation, and their combined capital was increased to 646 million marks (say, 32,300,000*l.*); now it is announced that the capital is to be raised to the enormous figure of 1100 million marks (55,000,000*l.*). It is well known in chemical circles that dyestuff-manufacture now represents only a very small part of the activities of the I.G. Before 1914, Germany supplied 75-80 per cent. of the world's requirements in dyes; to-day its export trade is relatively very small, and except for a marked revival in exports of zinc oxide and 'lithopone,' it is continually diminishing, whilst importations are steadily increasing. In the opinion of many German industrialists, the practical monopoly enjoyed before the War is unlikely ever to be regained. Manufacture of dyestuffs and pharmaceutical products has now become of inferior importance to that of fertilisers, such as synthetic ammonium compounds and urea, and these materials are responsible for most of the profits made. Nothing is more astonishing than the development of the nitrogen-fixation industry, and the long-threatened competition between it and the Chilean nitrate industry has materialised, to the great discomfiture of the latter. The most fundamental factor in the nitrogen-fixation industry is the cost of hydrogen, and every effort is being made to reduce this cost by extending its uses. This accounts for the interest which the I.G. is taking in the hydrogenation of coal and peat, and in the artificial production of light motor-fuels.

THE ramifications of the German Dye Trust are too intricate and deep-seated to be divined by those outside the inner ring; and they are probably very numerous, if one may take a line from the activities of some of our own large chemical undertakings, the interests of which are known to extend far beyond the sphere of industrial chemistry. A letter from the Frankfurt correspondent of the *Times*, printed in its issue for August 27, throws a little light upon the ever-extending interests of the I.G. and upon the uses to which the new capital may conceivably be put. It may be taken as fairly certain that a good proportion of it is earmarked for developing and extending the nitrogen plants and for financing the rapidly increasing trade in nitrogenous products. The fact that compound fertilisers are in chief demand to-day in Germany, necessitates abundant supplies of phosphates and potash, and it is confidently asserted that the I.G. is contemplating some arrangement with the powerful Potash Syndicate. By absorbing the important Köln-Rottweil explosives company, the Dye Trust has obtained a dominant position in the German artificial-silk industry. That industry has already come to terms with certain foreign producers—including, it is stated, Messrs. Courtaulds—and rumour now says that an understanding with French and Italian manufacturers is in prospect. The Dye Trust, through one of its subsidiaries, is the largest producer of raw films in Europe; co-operation or fusion with its two chief competitors, the Eastman Kodak Co. and Pathé Frères, is said to be maturing. Rumour is also busy with the industrial exploitation of the Bergius process, although its commercial success is by no means assured. The board of the I.G. has officially announced its intention to erect a large plant "for the liquefaction of coal," but it has not stated which process is to be adopted. In many quarters it is believed that the statement refers to the manufacture of light motor-fuel by a process other than the Bergius, and that it is this other process which is the subject of negotiations with British, Dutch, and American petroleum companies.

ALL who are interested in bibliography and in scientific organisations, particularly from the international point of view, will welcome the appearance of the first issue of the *Bulletin for Scientific Relations*, dated July 1926, which has just been published by the International Institute of Intellectual Co-operation of the League of Nations (price per annum, 24 francs, France; 2 dollars for other countries). Written mainly in French, partly in English, the journal deals with many phases of scientific activity, including the results of inquiries initiated by the Institute itself. In the first section, which is devoted to bibliography, general and special, and to libraries and research centres, nothing strikes one more than the interest which Russia is showing in these matters. Soviet Russia is stated to possess 28 libraries containing 50,000 volumes or more, and in these are located more than 16 million volumes, the public library in Leningrad alone containing 4,134,000—the largest library in the world. Moscow has 140 scientific libraries, about 100 of which have been established since 1917, and in May 1925 a bibliographical library containing more than 10,000 volumes was opened to the public. The library of the University of Amsterdam has been enriched by a gift of 10,000 French scientific books. Berlin possesses an information bureau for books and monographs that informs scientific workers where any desired book may be found, as well as a Government central office for scientific information, which co-ordinates bibliographies relating to natural science and procures either original or photostatic copies of the publications mentioned therein. Athens can now boast of a new library, housed in a fine building presented by the Carnegie Institute, and named "Bibliothèque gennadienne," after Gennadios, a former Greek minister in London, whose gift of books to the Greek Government is located in the library.

UNDER the heading "International Scientific Organization," the *Bulletin for Scientific Relations* records that in answer to a *questionnaire* sent out by the International Union of Academies concerning an international language, nine academies replied that they would prefer a living language to an artificial one; Italy asked for Latin, and Japan for Esperanto. This section contains a long report from the International Bureau of Meteorology, also references to the

establishment of microbiological institutes at Moscow and Buenos Ayres, and to the projected opening of a branch of the Pasteur Institute at Montreal. Under "National Scientific Organizations" mention is made of the proposal to remove the anthropological, prehistoric, and ethnographic collections from the Museum of History at Vienna, and to use them for the nucleus of a new "Kulturhistorisches Museum." A Kaiser-Wilhelm Institute for silicate chemistry has recently been founded in Berlin, with Prof. W. Eitel as director. In France a Petroleum Institute has been opened at Strasbourg. In Greece the Academy of Athens has been founded and inaugurated in a building which was intended for this purpose forty years ago. The Academy has three classes of members: pure and applied sciences, literature and fine arts, and moral and political sciences, the number of members in them being restricted to 25, 20, and 15 respectively. In Germany an institute for Chinese students studying in the University of Frankfort was opened at the end of last year.

MR. ERNEST MACKAY'S summary of the results of the Oxford University and Field Museum Expedition to Kish during the past season, in the *Times* of August 25, affords striking evidence of the importance of this site for the early history of civilisation in Mesopotamia. No less than three considerable buildings have been brought to light this year. Of these, one, a temple of Nebuchadnezzar, with walls standing 18 feet high, which is one of the best preserved in Mesopotamia, has another large building of the period of Hammurabi (2100 B.C.) beneath it, and possibly earlier buildings at a still lower level. A ziggurat of Sargonic date (2752 B.C.) is of unusually large proportions, while another building adjoining the Nebuchadnezzar temple is constructed of mud bricks of a size which points to the age of Dungi (2250 B.C.). The discovery of the greatest significance, if the interpretation offered be correct, comes from Jemdet Nasr, a mound on which were discovered fragments of painted pottery, both monochrome and polychrome, and the inscribed signs emerging from the pictographic state to which attention was directed at the time of their discovery in their relation to the evolution of writing from pictographic signs to the later cuneiform writing. The excavation of this mound showed that it belonged entirely to one period (*circ.* 4000–3500 B.C.), but a building discovered there proved to be built, not of the characteristic plano-convex bricks hitherto thought to be the earliest in date in Babylonia, but of a well-made rectangular brick, differing in size and shape from the later rectangular brick which ousted the plano-convex brick. It is thought, therefore, that the latter—an obviously inferior type—must have been introduced by a race of invaders and have entirely superseded the earlier form in Northern and Southern Sumeria, as there is no evidence that the two types were ever in use at the same time.

THE August number of the *Review* issued by the British Brown-Boveri Co. gives an excellent illustration of the trend of electrical development. We learn that Messrs. Brown-Boveri, the famous Swiss firm, is constructing for the New York Edison Co. a turbo-alternator set of 160,000 kilowatt capacity suitable for continuous running. As only a few stations in Great Britain have an output so large as this, it will be seen that it is a bold undertaking. The high steam pressure part, 265 lb. per sq. in., is to drive an alternator of 75,000 kilowatts at 1800 revolutions per minute, whilst the low pressure part drives an alternator of 85,000 kilowatts at 1200 revolutions per minute. This will be the world's largest turbine.

ANOTHER direction in which the Brown-Boveri Co. is specialising is in the manufacture of automatically controlled sub-stations. The importance of these stations in railway work has been long recognised. They are more expensive to build than hand-controlled stations, but the great saving in wages almost invariably makes their adoption advisable. There is no need to consider problems relating to the housing of the staff, and so the most economical site can be chosen. In a recently constructed sub-station for a Swiss railway they have installed a 300-kilowatt rectifier set which converts 8000 volts alternating pressure into 800 volts direct pressure. There is in addition a 300-kilowatt rotary converter for performing the same function. A time switch in the morning sets the rectifier into operation. If a long period of overload occurs a thermal relay operates and the rotary converter operates in parallel with the rectifier. If for any reason the converter failed to act and the rectifier was excessively overloaded, safety devices would act and an alarum would be sounded. In the event of a sudden serious disturbance, the relay tests whether the cause is permanent or not. It operates three times at intervals of ten seconds, and if the disturbance persists it shuts down the whole set. Even when the load is only one-third of the full load, the efficiency of the conversion at the sub-station is 92·5 per cent.

WE have received from Mr. Arthur MacDonald of Washington, D.C., a statement of proposals which he has put before the United States Senate advocating the extension of anthropological studies in certain directions. Among other matters he stresses the importance of the study of man after death, especially in the case of those who have been prominent in the political and scientific world. It is interesting to note that since the beginning of the last century the brains of quite a large number of prominent Americans, including Abraham Lincoln, Lewis Aggasiz, and Walt Whitman, have been studied after death. Mr. Macdonald has also opened up a new line of inquiry in studying the political activities of American senators. In the sixty-second Congress, which lasted over three sessions, he found that the attendance was better in the first and third sessions than in the second, while Progressive Republicans showed a higher percentage of voting than Conservative Republicans. Business men attended quorum calls more and "yea and nay" calls less than professional men, but professional men averaged higher than business men in their frequency of remarks on the

Senate floor. Curiously enough, success in both public and private legislation varied inversely with education; that is, the better educated the senator, the less his success in legislative activity. Mr. MacDonald maintains that continuous study on these lines and a comparison with similar studies of legislatures in other countries should prove valuable, and probably lead to modifications of legislative procedure. It must be confessed that the utility of these studies is not immediately apparent. Abstract studies on statistical lines of political activities, such as frequency of voting in division, introduction of legislation, public and private, and the like, can have little scientific value when considered *in vacuo* and apart from attendant conditions which, from the nature of the case, it is almost impossible to ascertain.

PROF. A. F. C. POLLARD has prepared a Subject Index to volumes 1-25 of the *Transactions of the Optical Society* on the lines set out in his manual on the Decimal Bibliographical Classification of the Brussels Institut International de Bibliographie recently published by the Optical Society. It is printed on one side of the paper only, so as to be suitable for gumming to the ordinary 5 in. × 3 in. catalogue cards. A paper appears under each subject with which it deals, and to each subject is assigned a number, as in the original Dewey decimal system of 1876. This number appears at the right-hand top corner. At the left on the line below is the name of the author. Next below is the date in the order 1923.05.24 and the descriptive title. On the next line the reference in the order-title of publication, volume, year, pages. The manual explains the system of notation, which from 535 = Light gives 535·5 = Polarisation, 535·54 = Chromatic Polarisation, and 535·543 = Colours of thin Plates, and with (02) for Treatises gives 535(02) = Treatises on Light. The system was adopted at Brussels in 1899, but was not used in the International Catalogue of Scientific Literature, where Light had the range 2990–4470 assigned to it. As a system it appears both concise and comprehensive, but it has not yet been accepted as international, although it has been in existence more than a quarter of a century.

PROF. POLLARD'S Subject Index introduces an innovation into the method of indexing individual scientific journals, and it will be interesting to see with what favour the scheme is received and how far the movement will extend to other learned societies and journals and lead to some uniform and standard method of indexing. For, although the Dewey system has been adopted extensively in the libraries of Great Britain for their book classification, the Brussels scheme for indexing periodicals has not so far found much practical application. A few, notably French journals, habitually arrange their monthly abstracts of current literature in this order, and some, including certainly one English, even label the original articles in each issue with the appropriate Brussels notation, but none as yet, we believe, has extended the system to annual or consolidated indexes.

IN the June issue of *Medical Life* (vol. 33, p. 261), Prof. Tenney L. Davis has a short note on Boerhaave's attitude toward alchemy. A remarkable feature of the "Elementa chemiae," a book which did much to establish its author's reputation, is that it does not discuss the phlogiston doctrine of Stahl, and Prof. Davis interprets this silence to mean that Boerhaave thought the doctrine unimportant. Boerhaave, in short, was interested in facts, and was always ready to weigh and consider. This trait made him extremely tolerant and sympathetic in his treatment of the alchemists, whose habits of wide experimentation and careful observation did not, however, prevent him from doubting "whether these skilful persons, after they had discovered so many extraordinary things by naked observations, might not by a too great quickness of apprehension anticipate, and relate things for facts, which they conclude might be done; or even must of necessity have been done, if they had persisted in the pursuit. . . . Credulity is hurtful, so is incredulity: the business, therefore, of a wise man is to try all things, hold fast what is approv'd, never limit the power of God, nor assign bounds to nature."

SOME American museums are accustomed to publish reports of the explorations and travels on which members of the staff have been engaged, while reserving the scientific results for more weighty publications. This has the advantage of encouraging the traveller to observe and note facts subsidiary to his main object, and of preserving a record of details interesting in themselves but not important enough to warrant a formal paper. Thus the Yearbook of the Academy of Natural Sciences of Philadelphia for 1925 contains well-written and well-illustrated accounts of such journeys. Francis W. Pennell describes "Botanical Travel in Peru and Chile," his main objective being the Scrophulariaceæ of the central and southern Andes. Witmer Stone writes on "Past and Present Bird Life of the Southern New Jersey Coast," and publishes some good photographs of terns and skimmers. Samuel G. Gordon reports on a mineralogical expedition to Bolivia and Chile, but manages to introduce photographs of glaciers and mountain lakes.

ANOTHER such volume is "Explorations and Field-work of the Smithsonian Institution in 1925." This contains an account of Dr. Hrdlička's seven months' journey to some of the chief palæo-anthropological sites in the world. The photographs of the locality from which the Pithecanthropus remains were obtained, of the finder of the Rhodesian skull, and of the quarry that yielded Australopithecus, are of particular interest. Dr. C. D. Walcott's geological explorations in the Canadian Rockies, Dr. Bassler's field-work in Tennessee geology, and Mr. C. W. Gilmore's collecting fossil foot-prints in Arizona are among the numerous articles that show the value to the museum of detailing members of the staff for field-work. There are twenty-six such reports in this volume, ranging from field-work in astrophysics

by Dr. C. G. Abbot, to experimental breeding of the mollusc Cerion at the Tortugas, by Dr. Paul Bartsch.

THE thirty-eighth Congress and Health Exhibition of the Royal Sanitary Institute will, at the invitation of the Town Council, be held at Hastings on July 11-16, 1927. The Right Hon. Sir William Joynson-Hicks, Bart., Home Secretary, has consented to act as president of the Congress.

THE eighth International Congress of Psychology will be held at Groningen, Holland, on September 6-11. Sections will be formed for the discussion of eidetic imagery, psychogalvanic reflex, higher psychic processes, animal psychology, psychopathology, and applied psychology. Papers will be read by the following British psychologists: Mr. F. C. Bartlett (Cambridge), Dr. Wynn Jones (Leeds), Dr. Thouless (Manchester), Dr. Aveling, Dr. Ernest Jones, Dr. C. S. Myers, and Prof. Spearman (London). Altogether nearly a hundred papers will be read.

THE issue of *The Fight against Disease*, the journal of the Research Defence Society, for July, contains an obituary notice with an excellent plate of the late Mr. Stephen Paget, who died in May. He was the founder of the Society and of its journal. Dr. J. A. Murray's address at the annual meeting of the Society on "The Experimental Attack on Cancer" is also printed; it gives a good summary of the subject, and tells just how far we have advanced in the knowledge of cancer by experimental methods.

THE Department of Glass Technology of the University of Sheffield has recently published vol. 8, 1925, of its experimental researches and reports, consisting of papers collected from the *Journal of the Society of Glass Technology*, the *Journal of the Royal Society of Arts*, and the handbook to the annual meeting of the Society of Chemical Industry, Leeds, May 1925. Most of the papers describe the work which has been carried out by Prof. W. E. S. Turner, Dr. S. English, and Mr. A. Cousen on the physical properties and the chemical constitution of various glasses. In addition, the publication contains articles on the glass industry and the modern production of sheet glass.

MESSRS. Isenthal and Co., Ltd., inform us that their address now is Ducon Works, Victoria Road, North Acton, W.3, where all communications and inquiries should be sent. The change of address has been necessitated by the expansion of the business, chiefly in connexion with the manufacture of overhead high-tension switchgear, protection apparatus, automatic voltage regulators, etc., all of which now demand more spacious premises than it has hitherto been found possible to devote to them. The manufacture of resistances and the development of some important new lines will also benefit by the greater facilities now at Messrs. Isenthal's disposal.

UNDER the direction of Prof. Doello-Jurado, the Museo Nacional de Historia Natural of Buenos Aires has resumed its custom of distributing a fairly comprehensive "Memòria Anual." That for 1924 (dated 1925) has just been received. It records the celebration of the centenary of the Museum on December 31, 1923, gives an account of the activities of the staff and of the chief accessions, illustrated by 44 half-tone plates, and discusses the proposed new building. Among numerous expeditions, the most noteworthy was that to South Georgia to obtain examples of cetaceans, pinnipedes, and birds. Chief stress, however, is laid on the renewal of collections in vertebrate palæontology. Rich though the museum is in this department, the older material is not always furnished with those precise details of horizon and locality now esteemed indispensable. Among the fossils collected are crania of Scelidodon, bones of Promacrauchenia and Protohydrochœrus from Monte Hermoso, skull and bones of Lestodon and other mammals from the later deposits of Playa de Barco. Apparently the enforcement of the law forbidding the export of palæontological, archæological, and anthropological material before it has been passed by a commission, has proved a difficult and laborious task. It resulted, however, in the retention for the Museum of a fine mandibular ramus of Pyrotherium and a few other desiderata from the collection made by Dr. Elmer S. Riggs for the Field Museum, Chicago.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A European science master at the Agricultural School at Moor Plantation, Ibadan, Nigeria—qualified to teach mathematics, chemistry, physics, and botany to about Junior Local standard—The Secretary, C.A. (N.), Board of Education, Whitehall, S.W.1. Scottish candidates should apply to the Secretary, Scottish Education Department, S E.D. (N.), Whitehall, S.W.1 (September 27). A professor of economics in the University of New Zealand—The High Commissioner for New Zealand, 415 Strand, W.C.2 (September 30). A head of the Department of Chemistry of the Witwatersrand Technical Institute—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (September 30). A museum assistant at the Royal Botanic Gardens, Kew—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (October 4). A whole-time research worker at the Calcutta School of Tropical Medicine for the investigation of hookworm disease from the point of view of its effect on the health on labour forces—The Director, School of Tropical Médicine and Hygiene, Calcutta (November 30). A laboratory assistant for the Veterinary Research Division of the Agricultural Department of the Government of Kenya—The Crown Agents for the Colonies, 4 Millbank, Westminster, S.W.1 (quoting M/14661). A visiting lecturer on engineering quantities and estimates at the Borough Polytechnic Institute—The Principal of the Institute, Borough Road, S.E.1. A director of the National Institute of Poultry Husbandry—The Principal, Harper Adams Agricultural College, Newport, Shropshire.

Research Items.

Pre-hispanic Jewelry in Colombia.—Among the contributions to the session at The Hague of the thirty-first International Congress of Americanists which have recently been published is a description by Dr. Paul Rivet of two collections of pre-hispanic jewelry in gold and gold and copper—one of Chibcha manufacture, the other Antioquian. Although they represent two entirely distinct industries, they have a common technique which is identical on general lines and is also related to the technique of the gold ware of Chiriqui, Panama. The Colombian gold industry was carried by the Chibcha far beyond the bounds of Colombia, and the whole of Ecuador and the Peruvian coastal areas appear to have come under its influence. In the same region an entirely different industry, originating on the Peruvian-Bolivian plateau, has been superimposed. Unlike the Chibcha industry, which is confined to gold and gold-copper, this superimposed industry works in copper, gold, tin, silver, exceptionally lead, and the alloys of these metals. The Chibcha industry, notwithstanding its high development, is probably not indigenous. It may be derived from the industry in an alloy of copper and gold, which the Spaniards found on their arrival among the inhabitants of the Antilles and the area north of the Amazon-Venezuela and the Guianas. This alloy is identical with that of Colombia, and the industry may have been introduced into that area by a Carib invasion. The centre of its origin lay possibly in the hinterland of the Guianas, the legendary site of El Dorado, and may have given rise to that tradition. The antiquity of the Carib invasion must be considerable, as the Chibcha technique appears on the Peruvian coast so early as the proto-Chimu period of Uhle.

Vital Statistics of Southern India.—A study of the vital statistics of southern India, by Major A. J. H. Russell, which appears in the *Scientific Monthly* for July, brings out some interesting points bearing upon the question of the conservation and promotion of the population. Of a population of 41,002,696 (1921), the Hindus form 89·48 per cent., Mohammedans 6·95 per cent., and native Christians 3·2 per cent.; other classes 0·04 per cent. A study of the population curve since the census was initiated in 1871, shows that southern India has very nearly reached an asymptotic population under present conditions. Indeed it has been necessary to import food stuffs during the last few years and, in spite of serious famine years and epidemics, the population is still too large for the methods of cultivation employed. The registered birth rate is 30·0 per 1000, but there is reason to believe that the birth-rate is really so high as 42·5 per 1000. In Madras City, where registration is more accurate, in 1922 it was so high as 41·2, and of 215 towns, 13 registered a rate of 40 to 50. The registered death-rate for the same period was only 21 per 1000, but actually it was probably 33 to 36 per 1000. In Madras City it was 43·1 per 1000. Infantile mortality was very high, although there has been a distinct downward tendency. In several of the largest towns this was so high as 311·6 to 352·8 per 1000, as against the English rate of 80 per 1000. Nearly 50 per cent. occur within the first month. This is attributed largely to the Hindu employment of 'barber' midwives, and it is significant that in the towns, 13·7 mothers die for 1000 births, the rate for the whole presidency probably being much higher.

Roger Bacon and Gunpowder.—In a recent issue of *Archivio di storia della scienza* (vol. 7, 1926, p. 34), Adolf Clément of Copenhagen offers a new and convincing solution of the famous cipher in Bacon's "Epistola de secretis operibus artis et naturae et de nullitate magiae." The passage in question, which it is only right to say has been regarded as of doubtful authenticity, reads: "Item pondus totum 30. Sed tamen salis petrae LURU VOPO VIR CAN UTRIET sulphuris; et sic facies tonitruum et coruscationem, si scias artificium." Lieut.-Colonel H. W. L. Hime interpreted the words in cipher by omitting *et* and rearranging the remaining letters into R. VII. PART. V. NOV. CORUL. V., which he translated "take seven parts (of saltpetre), 5 of young hazelwood (charcoal) and 5 (of sulphur)." Hime's solution (for a detailed account of which see "Roger Bacon Memorial Essays," Oxford, 1914, chap. xii.) has, however, been severely criticised by Lynn Thorndike, and is far less convincing than Clément's. Clément points out that the letters of the words in cipher can be rearranged into "pulveri carvonu tritov," the letters *s*, *m*, and a syllable *rum* at the end of *tritov* instead of *v*, apparently being lacking. It must, however, be remembered, he says, that the cipher was written at an epoch when abbreviations were in common use, and the three final letters of the words as rearranged are really signs of abbreviation, namely, *i* for *ĩ*, *i.e. is*; *v* for *ũ*, signifying *um*; and *v*, in *tritov* for ꝝ, *i.e. rum*. The sentence would then read: Sed tamen salis petrae, pulveris carvonum tritorum, sulphuris, etc.

Arabic Astronomy.—In a recent number of the *Sitzungsberichte der physikalisch-medizinischen Sozietät zu Erlangen* (Band 58, 1926, pp. 33-88) O. Schirmer continues the Erlangen tradition of the study of Islamic science. Inspired by Prof. Wiedemann, Schirmer has investigated some problems of Arabic astronomy, the most interesting being concerned with Arabic determinations of the inclination of the ecliptic. Two pages of figures of these determinations are given, chiefly, as might be expected, for Bagdad, Damascus, etc., though one was made at Toledo by Al-Zarqali. Al-Chugendi's description of his determination at Ray (near Teheran) in 994, for which he obtained the figures 23° 32′ 21″, is very clear. Prof. Wiedemann provides an appendix in which he translates the introduction of an astronomical work by Al-Nasawi; this contains a good deal of noteworthy historical information referring, *inter alia*, to the Aristotle of Islam, Avicenna.

Tabula Smaragdina.—Prof Julius Ruska, of Heidelberg, whose work on the history of chemistry in Islam is well known, has recently published an exhaustive study of the "Emerald Table" of Hermes "Tabula Smaragdina," Carl Winter's Universitätsbuchhandlung, 1926). He deals first with the ancient Hermetic literature, and discusses the conception of the god Thoth among the Egyptians. Passing in review Scott's "Hermetica," he rightly remarks that in sweeping aside all the alchemical books ascribed to Hermes as masses of rubbish, Scott was acting in a high-handed fashion, since "weder der Inhalt noch die Geschichte des ganzen Literaturkomplexes, der unter des Hermes Trismegistos Namen geht, gibt uns ein Recht auf solche grundsätzliche Scheidung und ungleiche Bewertung." A detailed study follows of Hermes and Hermetic literature among the Syrians, Arabs, and Persians, and Prof. Ruska shows that the attribution of the "Tabula" to Greek sources is probably not justified. He gives the Arabic text as found in a work of Jâbir ibn Ḥayyân, and also as it occurs in a collectaneous

MS. in a private library in Germany. He does not give credence to Jâbir's statement that he found the text of the "Table" in a work of Apollonius of Tyana, remarking that all we can be sure of is that by Jâbir's time (eighth century A.D.) a magical, astrological, and alchemical literature ascribed to Apollonius had grown up, but how much of it was genuine, or even from Greek sources at all, it is impossible to say. Prof. Ruska then deals with the "Emerald Table" in its Latin dress, exhibiting a wide and deep knowledge of medieval alchemical literature, but remaining interesting in spite of erudition—or perhaps because of it. The commentary of that enigmatical person Hortulanus is considered, and references to the "Tabula" and other Hermetic writings in Albertus Magnus, Arnold de Villanova, Trithemius, Paracelsus, and others are described. With one or two exceptions, such as the omission of any mention of the work on the "Table" published by Steele and Fulton, the book is extraordinarily complete, and contains everything that is of importance on the subject with which it deals.

HERRING AND PLANKTON.—The correlation of abundant plankton food with large catches of herring, if it can be successfully proved, should point to a means of great value for enabling fishermen to shoot their nets in areas most likely to be profitable, when the herring are actively feeding. In this connexion, Mr. R. E. Savage ("The Plankton of a Herring Ground." Min. Agric. Fish. Fishery Invest. Series 2, Vol. 9, No. 1, 1926) records the results of a cruise of the fisheries research vessel to study the plankton in the North Sea, in July 1922, off the mouth of the Tyne, where the herring fishery was very poor at the time. The catches of plankton on the fishing grounds, which consisted mainly of copepods, chiefly *Temora longicornis*, are stated to have been poor; while the region in which the plankton was most abundant did not coincide with the centre of the area in which the herring boats were fishing, but was some 20 miles south-east of it. Interesting observations are given on the vertical distribution of the different plankton organisms, together with a comparison of the distributions shown by day and by night collecting. It was found, by a series of hauls at each 5 fathom depth, that the deeper layers were generally richer in plankton animals as a whole in the daytime, and that the poverty of the surface layers extended to a depth of at least 10 fathoms.

VERTEBRATE DEVELOPMENT.—Volume 17 of the Carnegie Institution's Contributions to Embryology contains a paper on the origin of the rete ovarii and rete testis by Dr. K. M. Wilson, a description of the vessels of the sow's ovary by Miss D. H. Anderson, a physiological study of cortical motor areas in kittens and adult cats by Messrs. L. H. Weed and O. R. Langworthy, and a paper on the relations between the onset of decerebrate rigidity and the time of myelinisation of tracts in the brain and spinal cord of young animals by Dr. Langworthy. Dr. Wilson's most important conclusion is that the rete cords arise from deeply lying undifferentiated cells in the early sex gland and so indirectly from the cœlomic epithelium; thus they do not have a Wolffian origin. Miss Anderson's paper deals with the cyclic changes in the blood-vessels and lymphatics of the ovaries, and shows that both of these form double wreaths around the follicle, the capillaries growing inwards at ovulation and the lymphatics following two days later when the corpus luteum is becoming organised. Messrs. Weed and Langworthy determined the responses to electrical stimulation of the cerebral cortex in cats of all ages from birth, and found that in the newly-born ones movements of the contralateral fore-leg only were obtained, but in older ones not only these but also movements of the hind leg and of the facial-masticatory muscles were observed. The areas made out for the young kitten corresponded topographically to the same areas in the adult. In the paper by Dr. Langworthy, strong experimental evidence is presented of a correlation between the myelinization of the rubro-spinal tract and the occurrence of decerebrate rigidity. All the memoirs are illustrated by plates.

A DINOCEPHALIAN FROM SOUTH AFRICA.—Prof. W. K. Gregory has published in the *Bulletin of the American Museum of Natural History* (Vol. 61, article 3) a very detailed account, illustrated by 21 plates and 29 text figures, of *Moschops capensis*, a dinocephalian reptile. This study is based on very complete material, some seven or eight skeletons being represented, and, as a result, Prof. Gregory is able not only to describe the osteology but also to discuss the relations of this animal, its probable food and habits, and to make a restoration of it as it appeared when alive. Moschops, a semi-aquatic animal, had advanced from the primitive reptilian condition in that its body was raised well off the ground. In the author's opinion it was derived from some Pelycosaurian ancestor.

JAPANESE EXTINCT MAMMALS.—Prof. Matsumoto describes in *Science Reports of the Tôhoku Imperial University*, Vol. 10, No. 1, various extinct mammals discovered in Japan, many of them being described for the first time. The paper is in three sections, the first dealing with Proboscidea. The chief interest of this account is the description of a new species of the genus Hemimastodon. This genus was first described by Dr. Pilgrim from Baluchistan from rather scanty material, and its existence was doubted by some authorities. Matsumoto's further evidence goes to support Pilgrim's determination of the genus as being a connecting link between the genus Phiomia (Palaeomastodon in part) and the later mastodons. Altogether fourteen species of Proboscidea are listed as occurring in Japan. The second section describes two pinnipeds, one an extinct form *Eumetopias watasei*, the other a specimen of *Odobaenus obesus*, the walrus, possibly of Pleistocene age. The third section deals with four new species of fossil cetaceans.

HYDROGRAPHY OF THE IRISH SEA.—An account of hydrographic observations made in the Irish Sea between Holyhead and Dublin, by Mr. R. J. Daniel in 1925, is published in the annual report of the Lancashire Sea-Fisheries Laboratory (Liverpool University Press). In this area the water is of practically the same temperature and salinity from surface to bottom, which greatly facilitates the survey of these two physical conditions which are being carried out regularly every month. A slow drift of ocean water passing north through the Irish Channel, strongest in some months and weakest in others, has been known for some time, our knowledge being based on inferences drawn from changes in salinity of the water. Mr. Daniel's observations at regular intervals of one month may be expected to give a record of the fluctuations in this drift of water from year to year. A point of interest, recorded in this report, is the considerable differences in surface salinity readings at near-by stations which occur sometimes, and the small differences, at each station, between the surface and deeper samples.

Bottom Currents in the North Sea.—Under the title "The Water Movements in the Southern North Sea, Part 2, The Bottom Currents," Mr. J. N. Carruthers publishes an account of an extensive experiment conducted by the Ministry of Agriculture and Fisheries, by means of 'bottom trailers,' of which some ten thousand were set free from a number of selected positions throughout a year (Fishery Investigations Series 2, Vol. 9, No. 3, London: H.M. Stationery Office, 1926). This ingenious method of observing the drift of the water close to the bottom, by means of bottles so weighted that they remain lightly poised upon their tails of wire, which are about two feet long, was devised by Dr. G. P. Bidder more than twenty years ago, and has been used successfully in several areas of the sea around the coast of Britain. The bottles trip along lightly with any horizontal movement of the water and escape the danger of becoming arrested by mud and rough ground to a much greater extent than any body resting directly on the bottom, until such time as they are caught in the trawl of a fishing vessel or go ashore on the coast. The number of days each has been out and the distance travelled gives an indication of the currents experienced in the course of its wanderings. An idea of the intensity of the trawl fishing in the southern part of the North Sea is given by the fact that 24 per cent of the trailers put out were recaptured by trawlers. Besides these a number were found on the coast, particularly in the case of those liberated from the Sandettie, Galloper and Outer Dowsing Light vessels, from the positions of which there is an onshore set of the deep water. The results of this extensive experiment show that current of bottom water flows in to the North Sea from the English Channel, spreads out fan-wise towards the East Anglia and Dutch shores and proceeds north-easterly. A current also flows south-east off the coast of Scotland and north-east England until it reaches the latitude of Flamborough Head, when it turns easterly and finally north-easterly, forming a counter clockwise swirl system in the vicinity of the South Dogger Light vessel. Water from the two currents mingle and proceed north towards the Danish coast. The speed of the residual drift or current at each of the chosen positions approximates to a mile a day.

A Current Meter for Deep Water.—Much ingenuity has been exercised in the design of meters for measuring currents in the sea during recent years, and considerable headway has been made with a difficult practical problem. The apparatus devised by Prof. V. W. Ekman more than twenty years ago has been used extensively and is probably the best known type. In *Publication de Circonstance* No. 91 (June 1926) of the Conseil International pour l'Exploration de la Mer, he describes "a new repeating current meter" which is a development of the original model for use in deep water. The aim has been to provide an instrument to be used in several hundred fathoms from a vessel riding to a single anchor, which does not provide a fixed point of suspension for the meter owing to the veering of the ship. With this instrument a number of 'messenger weights' are slid down the wire to which the meter is attached, one after another at noted times, and the meter registers the direction of the current at the moment when each 'messenger' hits it, together with the distance the current has travelled between successive hits.

The Compressibility of Rocks.—To test the rival hypotheses that beneath the earth's outer shell the material consists of peridotite or basaltic glass, L. H. Adams and R. E. Gibson, of the Geophysical Laboratory of Washington, have made direct measurements of the compressibilities of dunite and tachylyte (*Proc. Nat. Acad. Sci.*, May 1926). The results show that at a pressure of 17,000 megabars, corresponding to a depth of 60 km., the velocity of longitudinal earthquake waves in dunite would be 8·4 km. per sec. In basaltic glass the corresponding velocity would be 6·45 km. per sec., and in gabbro from 6·9 km. to 7·3 km. per sec. The actual velocity of such waves at a depth of 60 km. is about 8 km. per sec. It is concluded that this gives a very definite indication "that at depths greater than 60 km. we have a material more basic than gabbro and approaching dunite in composition." The new measurements show quite conclusively that Daly's conception of a substratum of basaltic glass meets with no support, but neither can the author's deduction be completely justified. Eclogite would probably satisfy the evidence equally as well as peridotite. It is to be hoped that similar work on this high-pressure facies of basalt may soon be carried out.

Radiation without Quanta.—The Montreal *Mercury* has issued as a pamphlet of 28 pages the two addresses given in April by Prof. L. V. King to the Physical Society of McGill University on the properties of a rotating electron in translatory motion. If the shortening of the axis of the electron in the direction of translation is taken into account, the equations of motion of the electron are shown to give a precessional motion of frequency ν which is connected with the translational velocity v by an equation of the form $h\nu = \frac{1}{2}mv^2$, where m is the mass of the electron when at rest and h is a constant for all electrons. Thus the quantity h of the quantum theory is introduced by classical dynamics as a property of the rotating electron. The extension of the idea to spinning protons and to atoms leads to the series formulæ for the hydrogen and helium spectra and to the *S*, *P*, *D*, and *F* series for other elements with the correct value for the Rydberg constant. The fine structure of lines, the Zeeman and Stark effects are explained as due to perturbations of orbits brought about by external fields. The radiation formula in terms of temperature and wave-length follow from a Maxwellian distribution of electron velocities.

Coal Carbonisation Tests.—The Department of Scientific and Industrial Research has issued a Fuel Research Technical Paper, No. 15, on the Carbonisation of Durham 'Holmside' Coal in Continuous Vertical Retorts (London, H.M. Stationery Office, 1926). The continuous vertical retort has gained its popularity largely because it lends itself to the production of the lower-grade gas which is usually distributed to-day. The tests recorded were made at the Fuel Research Station, Greenwich, at the request of the South Metropolitan Gas Company, which distributes a coal gas of calorific value somewhat greater than is customary in England, and it is of considerable interest to ascertain how far the continuous vertical retort can be applied to the production, from a typical Durham coal, of gas of the quality used in South London. It was found that the settings required certain modifications both in construction and operation, after which it was possible to produce the carbonisation results desired. The tests were extended to study the effect of steaming the charge, so as to obtain results comparable with those previously obtained on other coals.

Phytopathology and Private Enterprise.

IN most of the European countries, as is the case in England, the insect pests and fungus diseases of agricultural plants are dealt with by one phytopathological service, and in spite of the opposition to such a practice in America this union has been found to work satisfactorily, for if at times one branch may seem to be profiting at the expense of the other, the two have so much in common that it is probably the most logical system to adopt. As we in Great Britain are more or less interested in what is happening in the corresponding service on the continent, it may perhaps be opportune to give an account of the National French Phytopathological Congress held at Lyons on June 28-30, which we had the pleasure of attending through the kindness of the promoters, the P.L.M. Railway.

The meetings, on account of the heavy programme, began at the somewhat early hour—for an Englishman—of 8.30 A.M. and continued until after 6 P.M. M. Mangin, the director of the Natural History Museum, Paris, acted as president, and M. Boret, the ex-Minister of Agriculture, and several other deputies honoured the Congress with their presence. Some five hundred persons accepted invitations, and most of the surrounding countries were represented. The subjects discussed comprised papers on various entomological and mycological problems, the disinfection of the soil, the value of colloids in spraying, the relation of birds and field-mice to agriculture, and proposals for the establishment of regional committees to assist in the war against what may be termed shortly the enemies of plants. In view of the large quantities of certain chemicals employed in this fight—on an average 50,000 tons of copper sulphate are used, for example, in a year, and about one-third of that is imported—and the consequent increase in price which such a demand creates, the need for finding fresh insecticides and fungicides was also discussed, while motions were passed dealing with the necessity of obtaining nicotine plentifully and readily and the need for some sort of guarantee of purity in those chemical preparations used by the grower. The latter question, it may be said in passing, has been receiving of late some consideration in this country. The exhibits of the various research stations—Paris, St. Genis-Laval, Montargis, Mentone, etc.—and of various firms, notably those of Vermorel and Truffaut, were very fine, while a practical demonstration of spraying apparatus at Ampuis completed the work of the Congress.

Hitherto it has been left to a government to maintain a phytopathological service, either directly or indirectly, though there are notable examples of the enterprise of private associations in establishing and running laboratories for the study of diseases of the particular crops in which they are interested. Amongst these the Hawaiian Sugar Planters' Association, the Colonial Sugar Refining Company, the Assam Tea Planters' Association, and the recently founded Ceylon Tea Planters' Research Institute may be mentioned, while on a smaller scale we have seen the establishment of works' laboratories by several private firms in Great Britain for the study of certain problems affecting their businesses, but this is a side of which people are in the main ignorant, and indeed there is little reason why they should be enlightened. The fostering of the agricultural industry by the P.L.M. Railway in the area covered by their system dates fairly far back. It has to be remembered that in northern France the carrying trade of the railways consists largely of coal, wheat, and beet, but in mid and southern France the railway derives most of its revenue from flowers, fruit, and vegetables. In 1877, when Phylloxera threatened to wipe out the wine industry, the P.L.M. Railway recognised that its revenue was closely bound up in the prosperity of the vineyards and did its utmost to assist in the stamping out of this dread disease. The service instituted then served as a nucleus out of which has grown the present magnificent organisation, which as it exists to-day is almost entirely of post-war origin. It is quite distinct from the service maintained by the state, but in actual practice it works in conjunction with and is really supplementary to it.

That disease may seriously affect the returns of an industry we all know, though it is difficult to obtain definite figures. M. Raybaud, the chief inspector to the company, estimates the injury caused by insects and fungi throughout the globe at 10 milliards of francs per annum, of which one milliard's worth is done in France. That the former figure is probably a very fair estimate the following data collected haphazardly from literature and reduced to a par value will show; the estimates are for limited areas in most cases and for prices prevailing before or during the War. The Hessian Fly is said to cost the U.S.A. 20,000,000*l.* every year; in the State of Washington the Codling Moth injures apples to the tune of 800,000*l.*, and in another State 400,000*l.*; *Conotrachelus nenuphar*, one of the British "scheduled" pests, injures peaches worth 400,000*l.* in Georgia; leaf injury by insects to tobacco in Sumatra on 80 estates amounts to 750,000*l.*; Helopeltis causes about 200,000*l.* loss every year in the Dutch East Indies; *Phytalus smithi* 33,400*l.* to sugar-cane in Barbados, and figures are not available for the loss it causes in Mauritius, where it is a much more serious pest; *Bruchus pisorum* causes damage of more than 200,000*l.* in one province of Canada alone; *Thrips tabaci*, to those crops it attacks in the U.S.A., 600,000*l.*; Frit-fly in Britain in 1912 damaged 12,126,198 bushels of wheat which, if we allow 1*l.* per quarter, is equivalent to more than 1,515,000*l.*; the Brown and Gold Tail Moths have cost Pennsylvania and the neighbouring States 6,000,000*l.* loss annually; *Prosagrotis orthogonia* caused injury valued at 600,000*l.* in Montana in 1920; *Cylas formicarius*, where it is established in the U.S.A., causes a loss of about 1,500,000*l.*; *Sitotroga cerealella* in Pennsylvania alone 200,000*l.*; one scale insect (*Saissetia oleae*) takes an annual toll of 400,000*l.* from the Californian Citrus industry; and if we include grain pests, Ohio loses 200,000*l.*, Alabama from 800,000*l.* to 2,000,000*l.*, while *Calandra oryzae* alone caused a loss of about 2,000,000*l.* in the U.S.A. in 1918, but this was a particularly bad year. Damage on the grand scale is seen in the case of the Cotton Boll Weevil, which costs the cotton growers of the U.S.A. 35,000,000*l.* in lint and 5,000,000*l.* in seed, and the Pink Boll Worm, which is said to cause a loss of 10,000,000*l.* in Egypt. Then we have the more general estimates of 20,000,000*l.* for the injury to the forest and shade trees of the U.S.A., 1,000,000*l.* to the agricultural products of British Guiana, 1,350,000*l.* to the maize industry in South Africa, 25,000,000*l.* annual loss to the field crops in Canada, and a similar amount in Germany. A mycologist would probably be able to supply as astounding figures for the losses caused by fungi.

Satisfied as to the need, therefore, of keeping a watchful eye on the diseases of plants, the P.L.M. Railway maintains a central agricultural service bureau which carries on a progressive educative policy amongst the growers in the region covered by

its lines, providing them with the latest literature on every subject which may be of interest to them, arranges conferences and demonstrations at convenient centres to which large attendances are assured through free travelling facilities, visits to other countries to study the conditions prevailing there, and also provides free carriage on their system for chemicals and spraying apparatus. The conferences are not confined to university professors and researchers in phytopathology, but the chemist and physicist, the manufacturer and the engineer take their place beside the practical man. Lively discussions result from such a gathering of experts, and not unusually the grower is able to hold his own. We were particularly struck by the keenness of the grower in everything pertaining to spraying, and whatever may be the opinion prevailing in Great Britain as to its value, there can be no doubt that the French agriculturalist is a firm adherent to the practice.

The phytopathological is but one side of the work carried out by the P.L.M. Railway. Since 1912 it has founded 138 experimental nurseries for the training of the peasants, and also many school gardens, subsidised largely the research station at St. Genis-Laval and the Insectary at Mentone, experimented with many varieties of strawberries, established a nursery for growing cypress for hedging, and distributed hundreds of thousands of plants free, fruit trees, vines, black currants, asparagus, artichokes, tomatoes, and osiers being the chief, but potatoes and winter vegetables have also received their share of attention. In addition pisciculture, viticulture, and sericulture owe much to the liberality and the encouragement of the Company. A huge organisation and a well-filled purse have always been behind these movements. What is the result to the Company? In 1910 it carried 190,000 tons of fruit and vegetables, in 1925 this had grown to 488,850 tons, so that the results of its labours are reflected in the balance-sheet at the end of the year in such a way as to encourage the Company to continue in the work which they are doing with such conspicuous success. L.

A British Expedition to the Sepik River, New Guinea.

An expedition has been planned and is now being organised by Mr. V. A. C. Findlay, the object of which is to penetrate to the central mountain chain of New Guinea and locate the head-waters of the Sepik River. There is at present a theory that a large lake lies between the Victor Emmanuel Range to the north and the Muller Range to the south, which feeds both the Sepik and the Fly Rivers. In 1891 Sir William MacGregor reached a point on the Fly River in the territory of Papua at lat. 8° 11′ S., long. 141° 54′ E., and of recent years a number of explorations of the head-waters of the Fly River have been carried out by officers in the Papuan service. In 1913–14 Dr. Behrman's expedition proceeded up the Sepik River in what is now mandated territory and the advance party reached lat. 8° 11′ S., long. 141° 36′ E. in the Victor Emmanuel Range, but failed to attain the objective of the expedition, the source of the river. A survey was made up to the point reached by the advance party.

The object of the present expedition will be not only to locate the source of the Sepik, but also to cross and survey the country lying between the head-waters of this river and those of the Fly. Geological, anthropological, zoological, and botanical observations will be made on the way, and if the objective is attained, should lead to results of great importance, as the higher and hitherto unexplored parts of the central mountain chain should produce much new and valuable material in each of these branches of science.

The expedition will proceed by launch to the highest possible point on the Sepik, where a base will be formed. From this the main party will proceed into the hills. Should they succeed in reaching the Fly, they will return down this river, the base party returning down the Sepik independently. The base party will be in communication with the authorities at Rabal by radio, and the main party will keep in touch with the base by means of a small transmitting set. A kinematograph outfit will also be carried.

The personnel of the expedition so far as arranged at present consists of Mr. V. A. C. Findlay, leader and agricultural and topographical surveyor; Mrs. Findlay, engineer, radio operator and photographer; Mr. A. J. Hill, engineer and radio operator; Mr. K. H. Henderson, zoological and botanical collector; Mr. W. S. Malcolm, anthropologist; and Mr. C. T. Teychenné, geological surveyor.

The expedition has received the approval of the Royal Geographical Society, the Royal Anthropological Institute, and the Committee for Anthropology of the University of Oxford. The expedition is being organised under the direction of a council of which Lord St. John of Bletso is president, and Mr. Henry Balfour, The Hon. Mr. H. A. Casson, and Dr. A. F. R. Wollaston, are members. At the recent meeting of the British Association at Oxford a committee was appointed to co-operate in the work of organisation. The estimated cost of the expedition is 6000*l*., and contingently on that amount being raised, the expedition will leave England in the autumn of 1927.

The Pelagic Young of the Cod.[1]

Mr. Michael Graham and Mr. J. N. Carruthers have attempted to correlate the known distribution of the pelagic young of the cod with the theoretical distribution deduced from three factors—market statistics, wind records, and experiments with drift-bottles. The theoretical part is undertaken by Mr. Carruthers, the practical part, dealing with the actual catches of the young fishes, by Mr. Graham. In addition Mr. H. H. Goodchild investigated the food of the fry from the same samples. Three questions are involved in the present paper: First, to what extent the drift affects the pelagic fry in the North Sea; secondly, what is the distribution of the fry; and thirdly, what is the food of the young in the pelagic stage? To answer these questions the market statistics were used to ascertain the spawning-grounds and times, the methods being justified by previous work of one of the authors in 1924. A system of cruises was undertaken to fish for the larvæ and post-larvæ from these spawning-grounds outwards; experiments with drift-bottles were made and wind statistics consulted. The ascertained distribution was then compared with the theoretical distribution, and the results were found to be so much in agreement that the authors seem to be justified in their con-

[1] "The Distribution of Pelagic Stages of the Cod in the North Sea in 1924 in Relation to the System of Currents," by Michael Graham and J. N. Carruthers. With a section on "The Food of Pelagic Young Cod" by H. H. Goodchild, Fisheries Laboratory, Lowestoft. Ministry of Agriculture and Fisheries. Fishery Investigations, Series 2, vol. 8, No. 6, 1925. London: H.M.S.O.

clusion that the pelagic young of the cod are to a large extent carried by currents.

The method of fishing was by taking oblique hauls with Petersen's young fish-trawl, at first as close to the bottom as possible for ten minutes; then to shorten the warp to half the length used in fishing near the bottom, and tow for a further ten minutes; finally, to tow for ten minutes at the surface. It was not intended to investigate the distribution by depth but to obtain representative hauls from near the bottom to the surface. Thus the fishes from all three depths were mixed together in the sample. In the drift-bottle experiments those at the surface only were taken into account. Information as to the vertical distribution of the pelagic young and the vertical extent of the drift would be extremely interesting.

More than a thousand of these pelagic stages were investigated for food; the result, as was entirely to be expected, showing that from the time when it begins to feed the young cod's main food is copepods. Copepods are pre-eminently the food of the larva and post-larva at least up to the time of its settling down to demersal life. Mr. Goodchild finds that diatoms are practically of no importance as food, which also is not surprising, judging from our knowledge of the food of other baby gadoids. The presence of the few specimens he mentions is in all probability accidental.

The Haslemere Educational Museum.

NEW buildings for the Haslemere Educational Museum, founded a generation ago by the late Sir Jonathan Hutchinson, were inaugurated and opened to the public on August 27. He was an original and powerful influence in many ways; in his hobby of making and directing a museum he became a popular benefactor to the beautiful Surrey district where he had his home, and in the development of which into one of the best known areas for scenery, residence and holiday in the radius of fifty miles from London. The Museum, which was formed and arranged with the educational aim predominant of making every exhibit tell its tale to the average person who came to look at it, has until recently been the property of the Hutchinson family. They have now handed it over to a trust under a scheme by which the collection is placed in new buildings, a maintenance endowment fund is being formed, and the committee becomes representative of local and other institutions, which ensure it being widely popular and therefore educational to many.

The scheme owes much in inception and carrying out to the chairman, Dr. Arnold Lyndon, who presided at the ceremony on August 27, when Earl Midleton formally opened the buildings, and Dr. F. A. Bather, keeper of the Department of Geology in the British Museum, unveiled a memorial tablet to the late Sir Jonathan Hutchinson. A large and distinguished company assembled in the beautiful grounds behind the roomy old mansion in the High Street, which with large additions has been most happily transformed into an admirable Museum. These grounds, with the spacious verandah and lecture hall, make the Museum well suited for education gatherings, whether for instruction of classes or by special demonstrations, etc., or (what may be well looked for) to visits from scientific societies, field clubs, and perhaps summer schools and conferences.

An additional interest is added by the fine collection of so-called Peant Arts, the property for some years of the Peasant Arts Guild, having been donated to the Museum and arranged in a special section. From an anthropological and ethnographical point of view, as well as from that of art and handicraft, this collection is important; there is no other in Great Britain made and arranged on the lines familiar to those who have visited Scandinavia and various continental cities where there are folk-museums. This Peasant Arts Section is entirely sympathetic to the aims and ideas of the late Sir Jonathan Hutchinson; a number of objects which he had collected have come into fitting spaces in this new phase. A great deal is due to Mr. E. W. Swanton, whom Sir Jonathan many years ago appointed as the curator of his Museum, and who, with the aid of Mrs. Swanton, has become a real educational influence in Surrey. This is recognised by the annual grant of the County Council (as Education Authority) to the Museum. Mr. Swanton is a many-sided man, as was the original founder of the Museum, and he may be trusted to carry the Museum on in the fine tradition which it has established.

University and Educational Intelligence.

A USEFUL guide-book to the universities of Germany has been published by the Akademische Auskunftsamt an der Universität Berlin. This has been compiled by Prof. Karl Remme, Director of the Central Office for Foreign Students in Prussia. It is an attractive volume of 290 pages, profusely illustrated and well arranged, and will be most useful to students proposing to visit Germany. It comprises an historical introduction, a general description of the higher educational system, statistical summaries, and chapters devoted to facilities available for foreign students, the distribution of subjects of study as between the different institutions, conditions for obtaining degrees and diplomas, and very readable descriptions of the university towns

RESEARCH in progress at the University of Minnesota, July 1924–July 1925, is described in a three-hundred-page pamphlet issued by the University's Graduate School. It contains the titles of about a thousand papers published or in the press and short abstracts of a large proportion of them. In addition it contains brief notes on the subjects and purposes of researches, the methods and materials used, and the results so far as available, in cases in which publication of papers has not been decided on. The index is not very satisfactory, names of researchers and classification headings of subjects of research being mixed in one series. If universities would co-operate in the production of annual lists of titles of subjects of research in progress, such lists could scarcely fail to be of considerable utility.

THE National University of Ireland's Calendar for 1926 exemplifies the tendency of such annuals to become unwieldy It contains more than 900 pages, chiefly lists of graduates and university honours. A list of published works and theses submitted for doctorate degrees from 1911 onwards contains about 200 titles and is followed by a footnote requesting professors, lecturers, and graduates to forward to the registrar "full details of publications and research work carried out by them." Of the six travelling studentships, each 200*l.* per annum for two years, announced for competition in 1925, only one was awarded, namely, in pathology. The subjects notified for travelling fellowships to be offered for competition in 1927 are: mathematical science, Irish together with English or French or German, philosophy, one of the three sciences, botany, zoology and geology, and anatomy.

Contemporary Birthdays.

September 4, 1845. Sir Thomas Barlow, Bart., K.C.V.O., F.R.S.
September 6, 1870. Prof. Frederick G. Donnan, C.B.E., F.R.S.
September 6, 1876. Prof. J. J. R. MacLeod, F.R.S.
September 7, 1877. Sir John Cadman, K.C.M.G.
September 9, 1867. Mr. Robert Ludwig Mond.
September 10, 1859. Prof. J. Norman Collie, F.R.S.
September 11, 1877. Dr. J. H. Jeans, Sec. R.S.

Sir THOMAS BARLOW, to whom congratulations are due on the anniversary of his eighty-first birthday, is Physician Extraordinary to H.M. the King. President of the Royal College of Physicians, 1910–15, he was also president of the International Medical Congress of 1913.

Prof. DONNAN, occupant of the chair of general chemistry in the University of London, was educated at Queen's University, Belfast, and at Leipzig and Berlin. From 1904 until 1913 he was professor (the first to be elected) of physical chemistry in the Muspratt Laboratory of the University of Liverpool. Prof. Donnan is a Longstaff medallist of the Chemical Society.

Prof. MACLEOD, Nobel laureate in physiology and medicine in 1923 (jointly with Dr. F. G. Banting), was born at Cluny, Perthshire. He was educated at the Grammar School of Aberdeen and the University there. Six and twenty years ago he was demonstrator in physiology, and afterwards lecturer in bio-chemistry, at the London Hospital, and for a time he was working with Dr. Leonard Hill on the physiological effects produced on animals by compressed air. From 1901 until 1903 he was Mackinnon research student under the Royal Society, taking up afterwards the chair of physiology in the Western Reserve University, Cleveland, Ohio. In 1918 he was elected to a similar post in the University of Toronto. The Nobel prize was awarded for the discovery of insulin.

Sir JOHN CADMAN was born at Silverdale, Staffordshire. He was educated at the High School, Newcastle-under-Lyme, and Armstrong College. Formerly a mining engineer and colliery manager, he established a practical acquaintance with all branches of the mining industry. Sir John is professor of mining and petroleum technology in the University of Birmingham, and technical adviser to the Anglo-Persian Oil Company. He is an Officer of the Legion of Honour.

Mr. ROBERT L. MOND was born at Farnworth, Lancashire, and educated at Cheltenham and Peterhouse, Cambridge. He is honorary secretary of the Davy-Faraday Laboratory. In recent years Mr. Mond has rendered signal service as a student of Egyptology and conductor of excavations.

Dr. NORMAN COLLIE has been, since 1902, professor of organic chemistry in the University of London. A past president of the Alpine Club, he is an ardent mountaineer.

Dr. JEANS, one of the secretaries of the Royal Society, was educated at Merchant Taylors' School and Trinity College, Cambridge. Second wrangler in 1898, he was Smith's prizeman in 1900, and sometime Isaac Newton student. From 1905 until 1909 he was professor of applied mathematics in the University of Princeton. In 1919 the Royal Society allotted him a Royal medal for researches in applied mathematics; in 1922 the Royal Astronomical Society awarded him its medal for his contributions to the theories of cosmogony.

Societies and Academies.

PARIS.

Academy of Sciences, July 12.—Charles **Moureu,** Charles **Dufraisse,** and C. L. **Butler**: Rubrene peroxide: new experiments. Rubrene peroxide, when dissociated by rise of temperature, emits light. In an earlier note it was shown that light was essential to the combination of oxygen with rubrene.—Miécislas **Biernacki**: The theorem of Lucas and its generalisations.—J. **Neyman**: A property of the law of probability which obeys the coefficient of variation.—Jules **Drach**: The integration of partial differential equations of the second order and the explicit use of the characteristic variables of Ampère.—**Decros, Rebuffet,** and J. **Villey**: An electrometric recording dynamometer. N. **Gunther**: The movement of a liquid filling a domain with multiple connexion which is displaced.—Ernest **Esclangon**: The asymmetry of sidereal space and the phenomenon of tides.—Marcel **Laporte**: The measurement of the mobility of ions in gases.—R. **Forrer**: The structure of the atomic magnet. Its normal position with respect to the network and residual magnetisation.—A. **Bogros**: The resonance of lithium vapour. The resonance line of the alkali metals is known to be the first doublet of the principal series. Direct experimental proof of this has been given for sodium and cæsium (Wood): the author now gives experiments proving it for lithium.—J. **Heyrovsky** and B. **Souček**: The electrolytic potential of iron amalgam. From measurement of the electrolytic potentials of iron amalgam, it is concluded that this amalgam should be metastable and decompose spontaneously, with liberation of energy, into a mixture of solid iron and mercury.—J. **Consigny**: The stopping power of some metals for α rays.—A. **Hamy**: The absorption of iodine by precipitated magnesia. Studies in the amount of iodine absorbed as a function of time, concentrations of iodine and of potassium iodide.—J. **Dumont**: The separation of the finer particles and colloidal constituents of the soil by centrifugation. The solid matter remaining in a clay suspension in water after standing for a day can be separated into two portions by a high velocity centrifuge, the portion remaining in suspension being considered as a true colloid.—Marcel **Bouis**: The synthesis of allene hydrocarbons. In an earlier communication a method was given for preparing ethylallene starting from vinylethyl carbinol. It is now shown that the method is generally applicable, the vinylalkyl carbinol, $CH_2 : CH . CH(OH) . R$, leading to the allene $R . CH : C : CH_2$.—Charles **Prévost**: A new erythrite. The glycols (*cis* and *trans*) $CH_2 . OH . CH : CH . CH(OH) . CH_3$ were converted into the ether oxides

$CH_2 . CH . CH - CH - CH_3$.
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Only from the *trans* glycol was sufficient ether oxide obtained to convert by hydration with water into the corresponding erythrite.—E. **Rothé**: The nature of the maxima inscribed in seismograms.—Albert **Baldit**: The periods of constancy of temperature at a station of medium altitude.—J. **Beauverie**: The modes of degenerescence of the chloroplasts, particularly in parasitism.—Mlle. H. **Popovici**: Contribution to the cytological study of the laticifers.—A. L. **Guyot**: Some parasitic fungi of the roots of Phanerogams.—A. **Rizzolo** and A. B. **Chouchard**: The quantitative study of the action of morphine on the cerebral cortex.—G. A. **Nadson** and N. **Meisl**: The mechanism of the action of chloroform on the protoplasm, the nucleus and the

chondriome of the cells of *Allium cepa*. The chondriome is the most sensitive to the action of chloroform; later, modifications are seen in the protoplasm, and last of all in the nucleus. The general character of the modifications produced by chloroform in the living substance is analogous with that of the changes provoked by X-rays.—Emile **André** and Henri **Canal**: Contribution to the study of the oils of marine animals. Researches on the oil of *Todarus sagittatus*.—Robert **Weill**: The problem of the cleptocnids. The nematocysts of *Hermœa bifida*.—André **Lwoff** and Mlle. Nadia **Roukhelman**: The variations of some forms of nitrogen in a pure culture of infusoria. From the point of view of the chemical transformations of the culture medium, and more especially from the point of view of the excretion of nitrogen in the form of ammonia and amides, *Glaucoma piriformis* (and perhaps all Infusoria) resemble bacteria.—A. **Vandel**: Triploïdia and parthenogenesis in the isopod *Trichoniscus* (*Spiloniscus*) *provisorius*.—M. **Lemoigne** and P. L. **Dopter**: The nitrogen losses caused by soil bacteria in pure cultures.—M. **Javillier** and H. **Alliare**: The existence of a nucleic phosphorus index of tissues.

July 19.—H. **Deslandres**: The law of distribution of terrestrial magnetic storms, and the corresponding law of distribution of the active regions of the sun. These are due to corpuscular radiation, which is subject to considerable periodic change.—G. **Bigourdan**: A means of improving the lunar co-ordinates deduced from the occultations of stars. The errors due to the irregularities of the edge of the moon's surface may cause an error of $1''$, whereas the error of observation gives the lunar longitude to about $0''\cdot1$. The application of lunar photographs is suggested as a means of reducing the error caused by the surface irregularities.—Charles **Moureu** and Adolphe **Lepape**: The determination of krypton and xenon in atmospheric air. An application of the spectrophotometric method previously described. The results (by volume) are: krypton, 1×10^{-6}, and xenon, 9×10^{-8}. These are about twenty times those obtained by Ramsay in 1903, but nearly identical with the figures obtained by Ramsay and Travers in 1900.—Charles **Richet** and P. **Lassablière**: The protective effects of chloralose in chloroform anæsthesia. From experiments on dogs it is shown that the administration of chloralose (which must be free from parachloralose) by the mouth prevents cardiac syncope by the action of chloroform.—Rolin **Wawvre**: The reduction of domains by a substitution with *m* complex variables, and the existence of a single invariant point.—Luigi **Fantappié**: A class of analytical functionals.—H. **Mineur**: Waves of discontinuity of the second order in an Einstein universe.—Henri **Bénard**: The limit of the laminar regime and the turbulent regime, revealed by the appearance of clear alternating vortices.—Farid **Boulad Bey**: The calculation of a continuous beam of any form when given vertical elastic deformations.—Da **Costa Lobo**: Correlation between the solar prominences and the filaments. The agitation of the surface of the faculæ. Results obtained with a large spectroheliograph set up at the astronomical observatory of the University of Coïmbra. This instrument is identical in dimensions and characteristics with the instrument installed by M. Deslandres at Meudon Observatory, and the results from one station will serve to fill up gaps caused by bad weather at the other.—W. H. **Keesom**: The curve of fusion of helium. Data are given for pressures and temperatures ranging from 77·09 cm. of mercury on the helium bath (T. 4°·21) to 0·057 cm. (T. 1°·13).—G. **Darrieus**: A relation between the gravitation constant and other fundamental constants.—Henri **Malet**: The mathematical synthesis of the laws of electrodynamics.—A. **Dauvillier**: The spectrography of X-rays of large wave-length.—Mlle. J. **Liquier**. The variation of the rotatory power of solutions of quinine salts as a function of the hydrogen-ion concentration. The rotatory power of asparagine and the salt effect.—Salomon **Rosenblum**: The retardation of the X-rays by matter.—Georges **Fournier**: The absorption of the β-rays by matter.—Henri **Belliot**: Experiments on photographic solarisation.—A. **Boutaric** and Mlle. G. **Perreau**: The existence of two zones of instability in the flocculation of certain suspensions by electrolytes with trivalent and tetravalent cations.—P. **Brun**: The miscibility of quaternary water-alcohol mixtures. Details of the study of miscibility of mixtures of ethyl alcohol and water with two other alcohols not miscible with water, isobutyl and isoamyl alcohols.—**Pariselle**: The tartrates of pyridine and quinoline.—A. P. **Rollet**: A new colorimetric determination of nickel. The colour reaction utilised is produced by the oxidation of nickel dimethylglyoxime and will show 0·0005 mgm. nickel in 1 c.c.—René **Girard**: The action of saline solutions on the ferrous metals.—Mlle. **Bardon** and Mme. **Ramart**: The action of organo-magnesium derivatives on the glycidic ethers.—Mlle. **Marthe Montagne**: Researches concerning the action of organo-magnesium derivatives on some fatty dialkylamides.—E. E. **Blaise** and Jean **Miliotis**: Researches on the transposition of functional groups.—Jacques **Bourcart**: The stratigraphy of the Bouches de Cattaro (Jugoslavia).—Paul **Caubet**: Eruption of the peak of La Fournaise, December 1925 to April 1926.—V. **Agafonoff**: The genesis of the black earth and other soils in the neighbourhood of Clermont-Ferrand.—Ch. **Jacquet**: Researches on the radio-active springs of the Puy-de-Dôme.—Henry **Hubert**: The general movements of the air in western Africa.—M. **Bridel** and C. **Béguin**: Biochemical researches on the composition of *Salix triandra*. Preparation of rutoxide, asparagine, and a new glucoside hydrolysable by emulsion, salidroxide. The leaves of this plant contain glucoside, which can be hydrolysed by rhamnodiastase and a glucoside which under the action of emulsion gives an essential oil smelling of rose.—René **Souèges**: The embryogeny of the Liliaceæ. The development of the embryo in *Muscari comosum*.—Jules **Amar**: Observations on the cellular pigments.—G. **Lafon**: The intimate mechanism of muscular contraction.—Charles **Perez**: The sexual characters of the caudal fin in the Galatheideæ.—René **Fabre** and Henri **Simonnet**: Study of the photo-sensitising action of hæmatoporphyrine.—F. **Vlès** and A. de **Coulon**: The receptivity of the organism for grafts of tumours, in relation with the iseolectric points of the tissues.—L. **Lutz**: The soluble ferments secreted by the Hymenomycetes fungi. Reducing actions.—E. **Fauré-Fremiet** and Mlle. Laura **Kaufman**: Remarks concerning the curve of annual decrease of eggs laid by the domestic fowl.—Constantino **Gorini**: The stimulation of the bacterial activities in milk.—A. **Paillot**: The etiology and epidemiology of the *Gattine* of the silkworm, or the transparent head disease.—H. **Bordier**: The action of diathermic d'Arsonvalisation on synovia.

Official Publications Received.

Bulletin of the National Research Council. Vol. 10, Part 4, No. 54: Quantum Principles and Line Spectra. By Prof. J. H. Van Vleck. Pp. 316. 3 dollars. Vol. 11, Part 1, No. 55: The Determination of the Protein Requirements of Animals and of the Protein Values of Farm Feeds and Rations. Report of the Sub-committee on Animal Nutrition. By H. H. Mitchell. Pp. 44. 75 cents. (Washington, D.C.: National Academy of Sciences.)

in the formation of protein chains a varied assortment of amino-acids is added according to a definite scheme. To build up the chain by the elimination of the elements of a molecule of water as each link is fastened to the next requires the expenditure of energy. This energy is supplied either by the radiant energy of the sun or by the oxidation of some other compound.

The mystery of life is not the creation of energy; it is essentially, as Prof. Driesch put it in a forceful address delivered this year, in London, the 'control' of energy—the control which out of a chaotic assemblage of materials whirling about in the fluid builds up a definite specific structure. The word 'regulation' coined by Driesch about 1895 to denote the mode of activity of his 'entelechy' and abhorred by the mechanistic school of which the late Prof. Loeb was the principal ornament and exponent, is creeping back into the vocabulary of experimental embryologists like Spemann and von Uebisch because the facts with which they deal will allow of no other explanation. The number of possible permutations of the order of the links in these protein chains is almost infinite, so that, as we have seen, the structure of the unfinished chain discloses no necessity of giving rise to a completed chain of a particular kind. Prof. Leathes speculates as to whether an occasional 'permutation' in this order may not be the cause of what biologists term a mutation. It is greatly to be desired that this word 'mutation' should either be rigidly defined or else removed from the scientific vocabulary altogether. Sometimes it is used to denote any change whatever in the hereditary potentialities of an organism, and then to say that evolution is explained by occurrence of 'mutations' is merely a truism. But the fact that this is a truism is often illegitimately employed to support another theory, namely, that violent and sudden divergences from type such as Prof. Morgan encounters in his cultures of Drosophila, and which form the 'sports' familiar to every breeder and gardener, constitute the raw material of evolution.

All the evidence at our disposal is hostile to such a suggestion: these 'mutations,' though they are certainly hereditary, are all characterised by weakened vitality and are unable to hold their own in the struggle for existence. This fact has been ably expounded in the address to Section D given by Prof. Osborn and printed in NATURE of August 21, who, in order to emphasise the view that the changes by which animals evolve are widely different from mutations, introduces the word 'speciation.' Further, as Prof. Leathes wisely says, a mutation is not eternal. This, indeed, is its most interesting characteristic; the sport transferred to a natural environment, where, in the absence of dangerous competitors, it has a chance to survive, will after a certain number of generations revert to type; like the feral pigs of Jamaica, which have gone back to the wild boar. We submit that the cause of a mutation is to be sought in the weakening or inhibition of one of the processes which make up the activity of the germ plasm, a weakening which under better conditions is transmitted to succeeding generations in ever-lessening degree and eventually disappears.

Prof. Leathes eloquently discourses on the relation of function to structure and rightly states that physiologists who study function are well fitted to make contributions to the doctrine of evolution. What is 'functional' survives, and structure is the expression of function. This is shown by the fact that the same type of cell, the fibroblast, or, as embryologists term it, the mesenchyme cell, will develop connective tissue fibres and give rise to tendon at the end of a muscle, and will form and deposit calcium phosphate where bone is required. Every particle of bone, he asserts, is the response of the organism to the strains which the exercise of its members brings about. These products of cell-secretion he terms irreversible, as opposed to the reversible changes which take place in muscle.

The difference, however, is after all only one of degree. Cary has shown that muscular fibrils are developed in mesenchyme cells under the influence of strain. In the embryo pig the gut-tube grows faster than its mesenchyme envelope, and the development of these cells into smooth muscles takes place in accordance with the elastic tension to which they are exposed, and, on the other hand, are not the osteoclasts which remove superfluous bone essentially identical with the osteoblasts which deposit it where it is required?

The fact is that the early exponents of evolution, being naturalists and morphologists, had only a superficial knowledge of function, and any structure the meaning of which was not obvious was ascribed to 'chance' variations which 'happened' to suit the environment. An example of this method of reasoning was the explanation of the dark pigmented spots found on the forehead of certain carnivora as devices intended to deceive their enemies into the delusion that the animal whilst asleep was really awake and gazing at them. As our knowledge of comparative physiology has progressed it has become more and more obvious that the whole body of the animal is an expression of its functions; or, as a zoologist would phrase it, of its reactions to its environment.

That the functions of cells are reactions to their environment was demonstrated in a beautiful way by Nageotte. He took a piece of sterilised bone from a rabbit's digit and implanted it in the cartilage of the ear. The introduced bone was soon surrounded by

"fibroblasts" drawn from the neighbouring fibro-cartilage and connective tissue. These invaded it and actually deposited new bone around it, although in the normal course of affairs these cells never would form bone.

Prof. Leathes also discusses 'the conditioned reflex.' This is most simply described as a new association of ideas, though Prof. Leathes interprets it as the establishment of a new machinery in the nervous system. The classical example is, of course, Pavlov's wonderful work on the dog, in which the animal was made to associate the sound of a bell with the arrival of food. As a consequence copious secretion of saliva was produced by the sound of the bell. Koffka in his book "The Growth of the Mind" has shown how powerless is the conception of fixed reflex arcs when examined in detail to explain the formation of the new associations. Leaving this special difficulty on one side, however, Prof. Leathes truly remarks that the establishment of new functional relations is only of importance in evolution if this rise of new functions—in a word, the acquisition of new habits in the parent—affects the offspring so that the establishment of the same functional relations in them is effected more and more easily as the generations succeed one another. As most people are aware, this is at once the most fundamental and at the same time the most hotly disputed question in biology. Pavlov has asserted that he has demonstrated, by his experiments on mice, that conditioned reflexes in parents do affect the children. These results have been received by the supporters of 'chance variations' with the same incredulity with which they have received other similar results obtained by investigators of less world-wide fame than Pavlov. Prof Leathes, as an impartial outsider, whilst awaiting confirmation by Pavlov himself of his own preliminary work, seeks to conciliate the more violent opponents by the use of the phrase 'parallel induction.'

By this phrase is meant the theory that whilst the body is incapable of affecting the germ cells which are embedded in it, yet an external influence may at one and the same time affect the body so as to provoke a new reaction and thus initiate a new structural change, and also affect the germ cells so that the next generation will show the same structural change. Surely this theory may aptly be described as the last ditch in which the opponents of the inheritability of acquired habits are prepared to die. Can it be seriously maintained that external changes in light and temperature can penetrate the somatic tissues and alter the deeply-seated germ cells, and yet that the body, which is in close physiological relation to these cells, is powerless to affect them?

Prof. Leathes makes a striking reference to the coincidence of the rediscovery of Mendel's laws of segregation in the hybrid offspring of different breeds, and the cytological discovery of the coming together of paternal and maternal chromosomes in the maturation of the germ cells and their subsequent disjunction into different cells. This 'meiosis' has been widely accepted as the physical basis of this segregation, and it is an hypothesis of seductive simplicity to take this view. But the whole history of physiology ought to warn Prof. Leathes of the peril of accepting simple mechanical explanations such as these. Again and again physiologists have believed themselves to be on the verge of simple physical explanations of vital functions, such as the diffusion of water from the blood through the glomerulus of the kidney, or the passage of oxygen through the alveolus of the lung, and each time closer examination has proved how disappointing and illusory such explanations are. In that wonderful school of cytological and Mendelian research established by the late Dr. Bateson in the John Innes Horticultural Research Institution, a body of devoted students have been studying Mendelian problems for years, and Miss Sverdrup's discovery that there are nine sets of independently segregating characters in the pea, but only seven chromosomes, is a result of just the same kind as physiologists have obtained in other fields.

In conclusion we may say that Prof. Leathes' eloquent appeal to his fellow physiologists to study functional evolution has our warmest sympathy. We feel convinced that if they respond to this appeal the whole aspect of evolutionary philosophy will be enormously changed and improved.

The Assaying of Brabantius.

The Assaying of Brabantius and other Verse. By C. S. Sherrington. Pp. iv+67. (London: Oxford University Press, 1925.) 4*s.* 6*d.* net.

THIS book of poems should interest all lovers of literature, not merely because of its author's eminence in the scientific world, but also for its own artistic quality. It contains the most accomplished verse that has been published in England by any man of science; and one of the most remarkable facts about it is that the point of view throughout is purely artistic. The poem on Keats, for example, is a poem of joy in the artistic handling of words. It shows them "in music swayed attire," shadows moved by the fire of thought. It shows them as "raised trumpets blown at morn," or as "foamed sea-capes calling through mist." It does not talk philology, but it finds them "still across this day of ours weaving fancy's storied woof."

The philistine who prides himself on his superiority

to 'words,' and on his inability to express his own ideas has conquered a large section of the literary world in recent years. Under a new disguise, as the advocate of a crude realism, and the opponent of what he calls 'rhetoric,' he has succeeded in convincing the thoughtless sections of the public that the incomparable language used by the rhetorical author of "Paradise Lost," with its infinitely subtle lights and shades, is less vividly expressive and less full in content than the broken-down jargon of the streets. Violence, the schoolboy use of the most conventional 'scarlet words,' is mistaken for strength, while the true use of language as an exquisite intellectual instrument, capable of the most precise expression of the subtlest ideas, is mistaken for smooth insipidity or what lisping school-girls now call, under the influence of weak-minded newspaper-ridden teachers, 'lack of guts.'

We are living, artistically, in an Aristophanic comedy. Prof. Ward in his really profound "Pluralism and the Realm of Ends" draws largely on Tennyson to elucidate some of the subtlest philosophical ideas of modern times. At the same moment a child of sixteen, quite unaware of any of those ideas, announced to her friends in Chicago lately, "I cannot wead Tennyson. He is so tewwibbly twite. But there's a poem in the *Little Weview* this month which I simply adore. It's so wed-blooded. It's about a bwothel." This is an extreme case; but it is a perfect illustration of the ignorance and conceit which have been allowed to mislead the arts, during the last decade or two, into the insane chaos where so much of the recent work has been floundering. It seems possible that if merely literary criticism cannot save the arts from self-destruction, the scientific mind may have to come over and help them, in the interests of our civilisation, with a little cool lucidity, and a few elementary lessons in rhythm, order, proportion, symmetry, and all that these things imply. When first principles go into the melting pot we may even have to re-demonstrate to our æsthetic agnostics that twice one is two. But science and art have one great common ground, in the ultimate unity of beauty and truth. That ground has never yet been fully charted or explored. The day may come when the golden mathematics of music, in its ascensions to heaven, and its unexpected opening of celestial gates, may unlock some of the most baffling problems of philosophy. Even now, when philosophical terms fail us, we can point to certain movements in a Beethoven symphony and say, "There—that is what I mean," not as an emotional, but as a logical solution. In the meantime it is all to the good that Sir Charles Sherrington in his lines on Keats appreciates so justly the æsthetic values of language. Words, to him, are not mere lifeless counters or labels, but creatures of the heart and mind of man, evolved through ages and having messages of "heavenly things to tell":

Words, deliverance of joy,
Words, blithe feet that move in dance,
Flute-throat words of girl and boy,
Pœaning the spring's advance,
Weeting death not nor mischance;

Words, heaped torrents swollen with rain,
Words, cloud voices league-long blown,
Words, begotten of human pain
Grief-matured through nights of moan;
Words like bell-towers sobbing in stone.

Art, as I suggested above, has its chaos; but philosophy has certainly its confusions. There is no precision of expression like the precision of great poetry. Modern thought would have been a century ahead of its present stage if certain famous philosophers had been able to express their ideas with the profound lucidity of Wordsworth's "Tintern Abbey." Sir Charles Sherrington's own verse has not that limpid depth. He is often a little wilfully tortuous and so he deliberately limits its effectiveness. But he strikes many chords that linger in the memory, and in his enthusiasm for great poetry his book is of real value to both science and literature.

The great dead—not they lie dumb,
Nor are their lips stopped with clay.
Listening fresh to their graves come
All the new-born every day.
We that breathe speak less than they.

There are many glowing pictures in the narrative poem entitled "The Assaying of Brabantius," of which perhaps the most immediately striking is the description of the sea-robbers' attack upon the lordly pleasure-house wherein Brabantius was losing his soul:

Where throngs
Of slaves flowed dancewise and made songs
To please the fanswept dwellers there
Pavilioned over perfumed air.
And how upon them broke a day
Brought, trespassing their sun-caped bay,
Fierce urgéd purple hulls of ships
With tumult filled from brine-caked lips,
And ear-ringed robbers little loath
Shook loose their knives, and, hoarse with oath,
O'erleaping row-bank, thwart and oar,
The beaked keels grounding, swarmed ashore
To clamber up the milky flights
Of graded marbles, till the heights
They won, and swept the pillared shade
Of court and dome and colonnade,
And slew, nor in their slaying stayed
Till all the dazzling streets bereft
Of life they left, and pool-strewn left
As market-stones are with wine lees
With blood the burnished terraces.

The influence of William Morris will perhaps be discerned in this. Here, as elsewhere, the remarkable fact is that there is scarcely a sign anywhere in the book that the author is interested in anything but his art. He never touches upon any scientific subject. But the scientific quality of his mind is revealed in the analysis of character in the "Assaying of Brabantius," which is certainly different from anything in William Morris, and more modern in feeling. It shows itself also in the sonnet entitled "Speech":

> And thus accomplished, after lapse of time,
> Dear meed of converse binds life's scattered ones,
> With healing of the schism of old prime
> As light rejoins the pulses of old suns.

Fragmentary quotation, however, is unjust to the book. It emphasises the somewhat deliberate archaism, and the twisted phrasing. Twisted though it be, it is artistically twisted, and there is a gleam of beauty on almost every page. The sonnet on Oxford is one that none of her sons and lovers who read it will easily forget:

> The night is fallen and still thou speakst to me,
> What though with one voice sole, with accents many,
> Tongued turret and tongued stream, tracked pasture fenny,
> And cloister spirit-trod, and centuried tree;
> And, bondsmen loosed in Time's tranquillity,
> Thy bell-dischargéd hours . . .
> And now, below, through shadows starred, a boat
> Steals by me laden with singing and young laughter
> And, higher, a wide-flung casement casts afloat
> Pulses of waltz the which white robes sway after;
> Sworn Priest of Beauty, these thy shrines among,
> That kneelst with old folk and that dancest with young.

ALFRED NOYES.

The Atom Again.

(1) *The Basis of Modern Atomic Theory.* By C. H. Douglas Clark. Pp. xx+292. (London: Methuen and Co., Ltd., 1926.) 8s. 6d. net.

(2) *Die Konstitution der chemischen Atome: Mechanische Theorien in Physik und Chemie.* Von Prof. Dr. Arthur Korn. Pp. 159. (Berlin: Georg Siemens, 1926.) 7·50 gold marks.

WHATEVER properties may ultimately be assigned to the atom, there is one which cannot be omitted—its power to seize and captivate the human mind. In fact, if we judged by the output of the printing press in the last few years, we might not unfairly assume that no sooner does any one fall within the sphere of influence of this radiating personality than he is seized with an irresistible determination to go home and write a book about it. Nor is this proselytising zeal confined to the pure physicist, whose protégé the atom may be presumed to be. We have books on the atom, some of them quite well done, by chemists, by mathematicians, by technicians, and by journalists, and addressed to all sorts and conditions of readers. Thus we have "Atoms for Amateurs," "Atoms for Adepts," "Atoms for Adolescents," "Atoms for Archdeacons," "All about Atoms for Anybody"—these are not the exact titles, but they indicate the scope of the volumes well enough—in fact, there seems to be a determination that no class of reader shall be left without an exposition of the subject suited to his condition and attainments. As these volumes continue to pour forth—there are two fresh ones before us as we write—we must assume that they find purchasers and readers. If we add to these the enormous output of serious scientific contributions from the many laboratories engaged in investigating the structure and properties of the atom, it is clear that this infinitesimal particle exerts an attraction unique in the history of science over the minds and imaginations of many types of men.

These reflections have been induced by the almost simultaneous appearance of the two volumes the titles of which are given at the head of this review. These differ in almost every conceivable way. One is in English, and is by a lecturer in chemistry; the other, in German, by a professor in a technical institute. One is a compilation involving an enormous amount of reading and abstracting; the other is an account of the author's highly individual speculations. They have only one thing in common. Both authors have been seized and fascinated by the subject, and cannot rest until they have expressed their enthusiasm in print. This, after all, is the only legitimate excuse for writing a book.

(1) Mr. Clark, in his enthusiasm, has read omnivorously and abstracted widely. In 282 pages he makes a clean sweep of the subject from Lucretius to Bohr, Sommerfeld and Debye. There can scarcely be any paper dealing with the atom which Mr. Clark has not consulted, and very few of which he does not make some mention. To have condensed so much into so small a space is a miracle of compression, and his difficulties have been increased by the fact that, as a chemist, he has thought it necessary to devote an appreciable part of his volume to the theories of Langmuir, Lewis, and the physical chemists which a physicist, straitened for space, would probably have been content to treat in a much more summary manner

It has evidently been the author's aim to include some reference to everything which has been either thought or discovered about the atom. To give anything like an adequate account of the subjects

touched upon in this book would require many volumes of equal size, and the author's treatment of the different parts of the subject is necessarily very brief and summary. We must confess to a personal prejudice against the author who skims lightly from flower to flower without extracting the last drop of nectar from each, and quotes formulæ without giving an adequate notion of the steps by which they are derived. For us, not only the chief value but also the main pleasure of science lies in the process rather than in the product, and we were inclined at first sight to regard Mr. Clark's book as falling under the ban of superficiality.

A closer reading, however, convinces us that the book performs a very useful piece of service. In geography we have original books of travel which give us minute accounts of various peoples and places; we have text-books, more or less voluminous, which give abstracted accounts of larger areas; and finally we have the atlas and gazetteer, which is content to tell us what places there are, and where to look for them; and each type of work has its uses. Mr. Clark has provided us with a gazetteer to the atom, and on turning over its pages one realises how much such a gazetteer is needed for this vast and ever-expanding tract of human knowledge. From this point of view the book is excellent. The student who uses it, and any one who is working on atomic physics may be recommended to do so, will find it a mine of information as to what there is to be known about the subject, while admirable lists of references and two good indexes will tell him precisely where to look for the information required. When next we are troubled by vague memories of a paper in some forgotten journal, by an author whose name we cannot for the moment recall and containing results which were probably important if we could only remember what they were, we shall certainly turn to Mr. Clark's book for assistance, and, if the paper has any reference to the atom, we shall not turn in vain.

We cannot congratulate the publishers on their share of the production. We recognise, with regret, that we cannot expect very many pages of print for 8*s*. 6*d*., and in this respect the publishers have not been ungenerous. The artificial increase in the mere bulk of the volume, produced by printing it on absorbent paper and appending a catalogue of general literature, adds nothing to our sense of its value, and does detract very materially from its appearance. The binding is poor and unattractive. The text is good enough to deserve a better dress.

(2) Dr. Korn's book differs widely in its purpose from the one we have just been considering. Whereas Mr. Clark records, almost without comment or criticism, the diverse views which are still current on atomic constitution, Dr. Korn's purpose is to develop and to popularise a highly individual theory of his own. He feels that his theory, as expounded in various papers in the *Physikalische Zeitschrift* and elsewhere, has not received the attention it merits; and surmising that this may be due to its highly mathematical form, he presents his views, in the present volume, in a way which he thinks will be within the capacity of physicists to apprehend. It is clearly outside the province of a book review to criticise original work of this kind. In brief, Dr. Korn proposes to add to the positive and negative particles which are known to be present in the atom, a third class of particles, gravitating particles, the existence of which has not yet been demonstrated experimentally. He then modifies the law of force between the particles by introducing an exponential term into the Coulomb law of force, and on these assumptions builds up a series of atomic structures the properties of which approximate, with some considerable degree of precision, to the properties of the known elements.

We think that physicists are more likely to be deterred from accepting Dr. Korn's theory by his assumptions than by his mathematics. The quantum theory in its applications to the Rutherford-Bohr atom is flowing on in a full current which shows no signs of abating. Unless and until it meets with some unexpected and quite unsurmountable obstacle, it is unlikely that the main stream of atomic science will turn back to flow along the alternative channel which Dr. Korn provides. Physicists, however, who wish to investigate this channel for themselves will find the theory excellently and fully expounded in Dr. Korn's book.

J. A. CROWTHER.

Aurora Polaris.

Australasian Antarctic Expedition, 1911–14. Scientific Reports, Series B, Vol. 2, Part 1. *Records of the Aurora Polaris.* By Sir Douglas Mawson. Pp. 191+6 plates. (Sydney, N.S.W.: Alfred James Kent, 1925.) 15*s*.

IN view of the connexion between ionisation in the upper atmosphere and the propagation of radio waves, special interest is likely to be taken at present in observations of the aurora and related phenomena, particularly in the regions where the aurora and associated ionisation are most strongly developed. The records of the aurora polaris from the Australasian Antarctic Expedition present the detailed observations from the three stations occupied by that Expedition between 1911 and 1914, and will be followed by two other parts in the same volume—" Records of Magnetic

Disturbances" and "Records of the Range of Transmission of Wireless Signals."

All three stations were situated fairly close to the southern auroral zone, a belt about the magnetic axis of the earth, but at some distance from it, in which auroral display is very frequent. Two of the stations were situated on the Antarctic coast and lay within the zone; the third, on Macquarie Island, lay outside it. Observations at Cape Denison (the main headquarters in lat. 67° 00′ S., long. 142° 40′ E.) were far more complete than at Macquarie Island (lat. 54° 30′ S., long. 158° 57′ E.) or at Queen Mary Land (lat. 66° 20′ S., long. 95° 02′ E.), which formed the western base of the Expedition. When combined with the results of previous expeditions, consideration of the azimuths in which the aurora was most frequently and least frequently observed from the different stations enables one to fix approximately the point of intersection of the magnetic axis with the surface of the earth in the southern hemisphere. This point lies, roughly, half-way between Cape Denison and the geographical south pole.

The visual observations of the aurora at the Cape Denison station are the most complete of their kind for any Antarctic observatory. The programme could not, however, be carried out as planned, since unfavourable weather rendered impossible the proposed photographic determination of the height of the aurora. The general sequence of events is what might be expected at a station lying a little within the auroral zone. The aurora is most frequently seen in the northern quadrants and least frequently in the southern. The normal quiet day sequence comprises a series of approaches from the north and retreats from the station, the aurora often passing overhead in the early morning, though the late afternoon is also favoured by the appearance of aurora near the zenith. During auroral storm periods, greater light intensity is accompanied by more vivid coloration and greater movement.

The most spectacular effects (the "intensity maximum") occur, however, shortly before midnight, at which time the aurora may pass to the south of the station. After the maximum southerly extension, the curtains may wane and retreat to the north, or rapidly spread in the heavens as a sheet of brilliant nebula. These very bright manifestations appear to be special phenomena superposed on the normal quiet day cycle, and it is worthy of note that certain short magnetic storms of "special type"[1] seemed also to be unusual phenomena occurring chiefly in the winter months and always very close to the time of the auroral intensity maximum at Cape Evans.

The local mean time of the intensity maximum differs at the various Antarctic stations and seems to occur, as in the north, shortly before local magnetic midnight, defined as the time when the station, the magnetic axis of the earth, and the sun all lie in the same plane. This relation is not indicated for the Queen Mary Land station, where, however, the observations were not so complete as elsewhere. Observations at the Macquarie Island station lying outside the auroral zone were also less complete than those at Cape Denison, but sufficient to show that strongly coloured displays were more marked at this station than at the others and often persisted for a long time.

Though the statistical method used is the only one adapted to bring out clearly the relative frequency of the aurora at different times of the day and its distribution in azimuth, an exceptional similarity in form is sometimes observed at the same time on successive days. These repetitions of form are much more striking than the repetitions occasionally observed on magnetograph traces, as indeed seems reasonable, since the magnetic disturbances are probably closely correlated with the *average* intensity of display in the auroral zone. This circumstance is probably in some measure responsible for the fact that the correlation between auroral activity and magnetic disturbance found by the British (*Terra Nova*) Antarctic Expedition was not more pronounced.

Special attention was paid by Sir Douglas Mawson to the observation at Cape Denison of the trend or orientation of the relatively straight auroral bands (arches) when near the zenith, which are a special feature of the early morning quiet day maximum. These were found to show a definite anti-clockwise rotation, a movement which may conveniently be expressed by the statement that the arches pointed roughly towards the sun during the dark hours when observation was possible. Probably, however, chief interest will be taken in the section of the report which deals with the observations of very faint auroral phenomena in the form of haze patches and arches. These very faint manifestations were quite impossible of discernment until the eye became fully accommodated to the dark, and could only then be seen by the most acute of the observers. They were seen to maintain themselves for many minutes and often for several hours, waxing and waning in intensity. The report does not, however, indicate what criteria were applied to distinguish these faint auroral effects from the night luminous clouds which have been observed elsewhere at a height of about 80 km.

Careful perusal of the report will probably leave the reader with the feeling that our knowledge of the aurora in high latitudes is still very incomplete and that, even in the field of investigation covered by the

[1] "British (*Terra Nova*) Antarctic Expedition, 1910–13"; 'Terrestrial Magnetism," p. 270; "Observations on the Aurora," p. 34.

expedition, there is much which requires further study. The occurrence of the very faint phenomena is a case in point. The anomalous behaviour of the aurora at the Queen Mary Land station furnishes another example, the fairly even distribution of the aurora in different azimuths at this station being difficult to explain in view of the relative infrequency of its occurrence in the zenith.

The enhancement of the diurnal variation in the magnetic elements in high latitudes on disturbed days during the winter indicates an associated ionisation comparable with that due to sunlight, and there seems no doubt that this ionisation is responsible for the interesting correlations between auroral and magnetic activity. Whether any effective correlation exists also between auroral activity and radio transmission in and across the polar regions is not known, but the promised Part 3 of the present volume should throw some light on this question.

Quite apart from these interesting correlations and the laboratory work in progress to determine the properties of the radiations responsible for the aurora and the constitution and form of matter which emits the auroral light in the upper atmosphere, an immense amount of research is still required to clear up the position. More determinations of height and more spectroscopic observations, particularly at great heights, are required at widely separated places and especially in the Antarctic. More work is necessary to determine the cause of the occurrence of unusual colours during unusually active displays and to determine the wave-lengths of the weaker lines of the spectrum and their relative intensities. The relation between the light of the night sky and the occurrence of the auroral green line seems to demand further investigation, as also the fact that the polar aurora appears nearer the magnetic axis of the earth in storm periods, while the occurrence of an aurora in low latitudes is on occasions of world-wide magnetic disturbance.

This list of problems is only a small selection from a very large number which require investigation before the accepted outline theory of the origin of aurora can usefully be elaborated.

Our Bookshelf.

Fourfold Geometry: being the Elementary Geometry of the Four-Dimensional World. By David Beveridge Mair. Pp. viii + 183. (London: Methuen and Co., Ltd., 1926.) 8*s.* 6*d.* net.

MR. MAIR states clearly in his preface the scope of his book, which deals essentially with the elementary geometry of a four-dimensional continuum of space and time, the existence of straight lines being assumed. His aim is to prepare the ground for an understanding of relativity geometry rather than to treat his subject as a special case of general manifold geometry. The terminology is evidently chosen from this point of view, and the distinction between 'time-like' and 'space-like' vectors is made early in the book and used throughout.

The author begins with an account of the line vector from which he builds the area, volume and super-volume vectors. He explains geometrically his frames of reference or lattices in two, three, and four dimensions in turn, deals with combination of vectors, defines the tensor operator and establishes the invariants for transformation of lattices. As examples he discusses the velocity vector, derives the Lorentz transformation and gives a brief account of the motion of a particle. One feels, however, that these results are not so much illustrations as part of the scheme of the book.

From the first the notation is carefully explained and chosen to foreshadow and fit the tensor operations which thus emerge naturally and easily. The style is lucid and precise. Such terms as 'perpendicularity' and 'parallelism,' for which new definitions are needed, are treated with admirable clearness. The dependence of results upon the straight line hypothesis is emphasised, and it is shown how the removal of this restriction leads to the wider problems of the curved fourfold, which, as Mr. Mair points out, are beyond the scope of the book, although he indicates the use of the geodesic. The idea of invariance for different lattices is well stressed so that the reader cannot fail to realise its importance. A knowledge of Cartesian geometry is assumed, but very little more. The careful diagrams and well-thought-out exercises interspersed in the text, together with solutions at the end, add to the value of this stimulating little book.

Essentials of Systematic Pomology. By Prof. Brooks D. Drain. (The Wiley Agricultural Series.) Pp. v + 284. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1925.) 13*s.* 6*d.* net.

THE increasing number of varieties of fruit and the uncertainties of commercial nomenclature render the study of pomology full of pitfalls, and the student and grower alike will welcome Prof. Drain's attempt to set forth the essentials of the subject in a lucid style, shorn of unnecessary detail. Though dealing with American conditions, the text-book should prove of value to workers in other countries also. In studying the principal varieties of hard and soft fruits the various points are tabulated into good and bad characters, with notes on distribution and extent of cultivation. Various keys for the classification of apples are considered, that of Carpenter and Stafford being regarded as the best, Shaw's key for leaves and Keil's group classification of the fruit also finding a place. Of special interest are the sections on fruit exhibition and judging, details of American rules being given with the appropriate methods of scoring points. Exercises for class work are suggested, with practical hints on the cold storage of soft fruits for examination at later dates. A glossary of pomological terms and a certain number of references are included.

The development of fruit varieties in North America has been closely connected with the settlement and

development of the country. The early explorers and settlers brought in varieties of fruit from their native lands, many of which successfully passed through a period of acclimatisation. Selection and breeding from these old stocks have resulted in the production of new varieties better adapted to the needs of the growing fruit industry. Inevitably, increasing confusion of nomenclature has resulted, and therefore the American Pomological Society has drawn up a code of fruit nomenclature, in an endeavour to simplify matters. This code has been considered as the final umpire since about 1865, the last revision of 1923 being that now in use. W. E. B.

Grundzüge der Paläontologie (Paläozoologie). Von Karl A. von Zittel. Neubearbeitet von Prof. Dr. Ferdinand Broili und Dr. M. Schlosser. Abteilung 1: *Invertebrata.* Sechste verbesserte und vermehrte Auflage. Pp. viii + 733. 17 gold marks. Abteilung 2: *Vertebrata.* Vierte vermehrte und verbesserte Auflage. Pp. v + 706. 15 gold marks. (München und Berlin: R. Oldenbourg, 1923–24.)

BOTH geologists and zoologists are much indebted to Prof. Broili, of Munich, and the enterprising publishers of Zittel's "Elements of Palæontology," for a rapid succession of new editions of this indispensable handbook, keeping it up-to-date. It is a compendium of facts, with references to the scattered literature of the subject, such as are needed for research in many directions, and the arrangement of the matter, as originally planned by Zittel, makes it easily used. It still tends to be conservative in admitting new hypotheses or schemes of classification, and most of the additional figures resemble those of the first edition in being actual illustrations of fossils rather than explanatory sketches. The work indeed retains all the essential features of Zittel's incomparable exposition.

In the sixth edition of the section on Invertebrata the mollusca have been particularly revised with the aid of Prof. A. Naef and Dr. J. Schröder. In the fourth edition of the section on Vertebrata, the mammals, birds, and fishes have been revised entirely by Dr. Max Schlosser. Prof. Broili has thus supplemented his own labours by securing the co-operation of other well-known specialists, and the result is an encyclopædic work which inspires confidence. There are more small misprints than should appear in technical statements that are so carefully edited; and the additions sometimes necessitate changes which are not attended to in the context. Until, however, another Zittel arises to re-write the whole from the beginning, the minor blemishes incidental to patchwork cannot be avoided.

The Natural History of the Oxford District. Contributions edited by Comdr. James J. Walker. Presented to the Members of the British Association for the Advancement of Science, Oxford Meeting, 1926. Pp. viii + 336. (London: Oxford University Press, 1926.) 10*s*. net.

IT was to be expected that the natural history of the country immediately surrounding a great and ancient university would have been studied with especial thoroughness. None the less, the naturalists attending the Oxford meeting of the British Association must have been impressed with the richness and variety of the plant and animal life and with the great geological interest of the district, as revealed in this handbook. The very abundance of the material at their disposal must have added to the difficulties of the task which the editor and his fellow-contributors set themselves and discharged with such conspicuous success. The volume consists of more than twenty short articles by authorities on their respective subjects. It opens appropriately with sketches of the physical history of the land forms and various other aspects of local geology. These are followed by accounts of the botany of the Upper Thames, and of the birds, insects, and other animals of the Oxford district. The final chapters deal with the entomological treasures in the Hope Department of the University Museum, the wonderful ethnological series in the Pitt-Rivers Museum, and the fine collection of early scientific instruments formed by Dr. Lewis Evans and housed in the Old Ashmolean Museum. The handbook constitutes a summary, and provides a record of local species, which will be of permanent value to such members of the University as are interested in biological studies, as well as to naturalists generally. It is perhaps permissible to suggest that, for the immediate purpose of its compilation, something a little less technical in style might have had an even wider appeal.

Clouds and Weather Phenomena: for Artists and other Lovers of Nature. By C. J. P. Cave. Pp. x + 31 + 23 plates. (Cambridge: At the University Press, 1926.) 5*s*. net.

FOURTEEN years ago, the Cambridge University Press published a book by Mr. Cave on "The Structure of the Atmosphere in Clear Weather," a well-known work on upper winds written by a meteorologist for meteorologists. "Clouds and Weather Phenomena," which is also published by the Cambridge Press, is of a very different type, and while a work on clouds by Mr. Cave will undoubtedly be read by most meteorologists, the book is not intended for those engaged in the study of the weather but for the general public, and more particularly for artists, whose knowledge of cloud forms is often shown by their works to be very slight. In accordance with this object, the book is written in the simplest manner and contains scarcely any reference to meteorological theory.

The first half of the text deals with the colour of the sky, including sunset colours, with rainbows, halos, and other optical phenomena, describing under what conditions and in which parts of the sky these are seen. The next section is devoted to clouds, the international nomenclature being followed and the types illustrated by twenty-two excellent photographs taken by the author, placed together at the end of the book. Some notes on the position and appearance of the moon at different seasons conclude the volume. Perhaps one may be allowed to express a doubt whether even an authority like Mr. Cave, backed by the Cambridge University Press, will be able to reform the ways of artists, but all meteorologists will extend a hearty welcome to the book and wish the attempt success. J. S. D.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Science and Psychical Research.

IN NATURE of July 31, Dr Tillyard, the well-known entomologist, reproaches Huxley for not being interested in the phenomena of what Sir Arthur Conan Doyle and others call spiritualism. He extends this reproach to all who consider the claim that from "the organism of the medium 'psychic stuff,' by the moulding of which they [the invisible operators] can produce at will the phenomena of independent voice, levitation, materialisations of portions of their personalities, and so on," so highly improbable that they refuse to spend their time and energy in the efforts required for obtaining or refuting proof. Yet it is by such limitations, and by them only, that science has hitherto obtained its results.

No doubt Dr. Tillyard, guided by the experience which he gained during a long and successful career in entomology, would refuse to investigate reputed cases of insects with bony skeletons suckling their young. Why then should he be so hard on the physicist who, on the ground of his experience, refuses to investigate levitation, or on the biologist who, mindful of Harvey's *omne vivum ex ovo*, considers his time better spent in his usual pursuits than in an investigation of reputed "materialisations of portions of personalities"?

Dr. Tillyard evidently approves of the scientific movement which displaced the medieval church from its position as the guardian of all knowledge—natural as well as supernatural. Why then should he object to that great majority of his fellow-scientists who think that the change would be for the worse if they accepted the guardianship of the medium? This, however, is what Dr. Tillyard really advocates; he is not satisfied with the liberty accorded ungrudgingly to any one willing to investigate even the most improbable phenomena; he wants physicists and biologists to leave "the broad highway" of science and to enter "The neglected side-path, foul with mire and overgrown with noxious weeds" along which the medium is anxious to guide them. If science did so help, its name would be superstition.

J. P. LOTSY.

LIKE Mr. Campbell Swinton, Dr. Lotsy confuses psychical research with spiritualism; he then charges me with reproaching Huxley for refusing to be interested in the latter! If he will again read carefully through the third paragraph of my article and follow it logically with the beginning of the fourth, he will see how far he has wandered from my meaning. He then selects the rarest and most puzzling of all psychical phenomena, namely, the ideoplastic moulding of teleplasm into forms resembling "portions of personalities," and says that I extend my reproach to all who refuse to consider this as a valid phenomenon worthy of scientific study! This would be rather like reproaching a peasant who lived in the middle of Asia for refusing to believe in the existence of submarines when he had never even seen the sea!

Dr. Lotsy is quite sure about what I would do if I were confronted with reputed cases of "insects with bony skeletons suckling their young." I am not! If one of our leading entomologists were to write to me and state that he had observed a case of one of the higher pupiparous Diptera suckling its young, I should most certainly want to investigate it, though I might feel sceptical about his use of the term "suckling." The more improbable the reputed facts, the more I should consider the weight to be attached to the reputation of the man who made the statement. If the fact were vouched for by three entomologists of the standing in their own science that Lodge, Crookes, and Richet hold in theirs, I should consider that a good case for investigation had been made out. The weak point of Dr. Lotsy's argument is that he tries to draw a comparison between something in entomology which has never been even 'reputed' to occur and something in another branch of science which many leading men of science state clearly has occurred in their presence under test conditions; so that the only question which remains is to decide whether it is really true or whether they are liars or under delusions.

As for Harvey's *omne vivum ex ovo*, I doubt very much if modern biologists are compelled to regard this as a strictly accurate statement of the origin of life. Certainly Dr. Lotsy himself does not, for he has been trying for years to get them to accept instead his own emendation of *omne vivum ex hybrido*! Personally I prefer Harvey's dictum, but I do not think that the first unit of life that appeared on our world was either an egg or a hybrid. Moreover, the phenomena of teleplasm do not controvert Harvey's statement. For the 'psychic stuff' itself is admittedly drawn from the physical organism of the medium, and the medium is "ex ovo." Even if the ideoplastic moulding is really done, not under the control of the subconscious mind of the medium but by the will of an invisible operator who has once lived in the flesh, that operator by his own claims and admissions was once "ex ovo." The facts of psychical research do not *contradict* any of the broad principles of biology.

Finally, Dr. Lotsy makes the usual blunder of those who, knowing nothing of the elementary principles of psychical research, persist in regarding the medium as the 'guide' in the experiments, whereas the medium is actually in trance and does not know what is going on. I can only repeat that the conditions of the experiments are just exactly what the researchers choose to make them; the facts can be studied and tabulated like other scientific facts. My plea is simply one for assistance instead of obstruction in the attempt to obtain them. To parody Dr. Lotsy's last sentence, "If Science do not so help, then her name is stagnation

R. J. TILLYARD.

Zürich, Switzerland,
August 26.

MR. CAMPBELL SWINTON'S account in NATURE of August 28 of the incidents connected with the Combermere photograph is both inaccurate and misleading. Since he uses my name so freely perhaps you will permit me to state shortly the true version. The whole story, with the photograph, will be given in the next number of *Psychic Science*—the organ of the Psychic College.

This photograph, which shows plainly the outline of an elderly man seated in an armchair, was sent to me with the endorsement of the Combermere family, who may be expected to know as much about the matter as their relative by marriage. On the back was written that it was taken by a certain lady at the time of the old peer's funeral, and that the shadowy figure was supposed to be the wraith of the

deceased man. This I showed (among fifty other psychic photographs) at the Queen's Hall, simply giving the facts as supplied by the family, and making no assertion myself, since I had no personal knowledge of the matter. Shortly afterwards, several violent letters appeared in the press from Mr. Campbell Swinton, in which he used such injurious terms as "photographic fraud." As to the seated figure, he gave in successive letters three different contradictory explanations; the first that it was a photographic flaw, the second, that the butler had crept into the room and seated himself in the chair; and the third, that plates if kept for some time before development may show strange images. He wound up by challenging me to publish in the *Morning Post* the 'ghost' photograph, alongside of a photograph of the peer taken in life. I at once sent up my photograph without any suggestion whatever that it would not reproduce. That statement is pure invention upon the part of Mr. Campbell Swinton. The editor refused to take the risk of an inferior reproduction, and could only guarantee a good one by touching up, which would be objectionable. A reproduction was afterwards made by the *Daily Sketch*, but whether touched up or not I could not tell.

That is all a technical question with which I had nothing to do. What was, however, strange and rather amusing was that when the photograph of the peer was finally published he proved to be remarkably like the 'ghost,' having a very high forehead and some indication of a short tufted beard. Thus the result of Mr. Swinton's labours was to add one more point to the argument for the authenticity of the picture. There is clear evidence that there was no male visitor or servant in the house who wore a beard.

ARTHUR CONAN DOYLE.

September 1.

[No useful scientific purpose would be served by the discussion in NATURE of the production of spirit photographs or of the reality and origin of the various phenomena manifested during séances with a medium believed to be in a state of trance and to know nothing of what is occurring. The main point of Dr. Tillyard's article in NATURE of July 31 was that scientific men generally presented an unscientific attitude to the subject of psychical research; and he pleaded for critical inquiry in a field hitherto mostly neglected by scientific investigators. This alone is the matter which we think may be usefully discussed in NATURE, or to which we are inclined to devote space.

In his letter Mr. Campbell Swinton raised the question of the alleged spirit photograph of the second Viscount Combermere, his uncle by marriage, and it is only just that Sir Arthur Conan Doyle should be given an opportunity of replying. We do not propose, however, to let other correspondents range themselves on either side in regard to the authenticity of the Combermere photograph, or to submit or expose evidence of psychic phenomena of any other kind. For the present, at any rate, correspondence must be limited to the plea made by Dr. Tillyard for "the *scientific* study of what are called *supernormal phenomena*."—EDITOR, NATURE.]

The Three-dimensional Reproduction of Tracks of β-particles Ejected by X-rays.

THE use of a stereoscopic camera by C. T. R. Wilson in the photography of tracks of β-particles ejected by pencils of X-rays led to the revelation of two types of asymmetry of initial direction of ejection (*Proc. Roy. Soc.*, A, 104, 1923). One is characterised by an excess of tracks having their initial portions in or near the plane containing the X-ray pencil and its electric vector; the other by an excess of tracks having a forward component in their initial velocities. They have been termed 'lateral' and 'longitudinal' asymmetry respectively. The former distribution reveals the partial polarisation of the primary beam, the preponderance of primary X-rays the electric vector of which is in the plane containing the cathode stream. The latter distribution has been accounted for qualitatively on the basis of Richardson's hypothesis that the absorption of a quantum $h\nu$ of energy by the electron is accompanied by the transference of the momentum of the absorbed radiation causing a resultant motion in the forward direction. A third feature of interest and importance revealed by Wilson's photographs was the existence of short, unidirectional, fish-like tracks with tails towards the X-ray source and produced only by X-rays of wavelength not exceeding about 0·5 Å.U. The phenomena of fish-tracks are most completely and satisfactorily explained by the application of the Compton quantum theory of scattering of X-rays.

In further examination of these features other investigators have adopted the stereoscopic method. F. W. Bubb, in an examination of the initial directions of β-particles ejected by polarised X-rays scattered by a paraffin block, has photographed the tracks directing the camera lens axes end-on to the X-ray pencil for the observation of lateral asymmetry and broadside-on for the observation of longitudinal asymmetry. O. K. de Foe and D. H. Loughridge have examined independently longitudinal asymmetry by stereoscopic photography from the broadside-on position. The latter calculated initial direction of ejection from measurement of depth in the photograph of the end of the initial straight portion by means of a stereocomparator, and of height and breadth by direct measurement by dividers.

The work of F. Kirchner involving the stereoscopic photography of tracks produced by Compton electrons was described by Prof. W. Wien in his paper "On the Direction of Electrons emitted by the Photo-electric and Compton Effects," read before Section A of the British Association on August 10, 1926. Prof. Wien referred to the difficulty of ascertaining correctly, by examination of the photographs stereoscopically, the initial directions of the tracks with reference to the primary X-ray pencil. This difficulty had been met to some extent by the co-option of observers who could not possibly have any 'Compton bias.' I myself experienced this difficulty in some work done in 1924 in which I examined stereoscopically tracks produced by $K\alpha$ copper radiation homogenised by reflection from rock-salt, and was led to consider the possibilities of photography in two directions at right angles eliminating the stereo-vision difficulty and at the same time increasing very considerably the precision with which the forms and initial directions of tracks could be determined. It appeared, too, that such photography would avoid two other difficulties inherent to stereoscopic examination of lateral asymmetry in which photographs are taken end-on to the pencil. Tracks would be formed across the full width of the cloud-chamber (15 cm., say), and it is impossible under the conditions of the experiment for all to be sharply in focus. Also, even in the absence of this difficulty overlapping and confusion is inevitable.

It was at once evident that the most suitable directions of the lens-axes, using separate single lens cameras and the direction of the primary X-ray pencil being horizontal, would be the vertical and horizontal perpendiculars to the pencil. The photographs so obtained would give the projections of

tracks on two perpendicular planes. Measurement of the angles made by the initial straight portions of the projections with the direction of the X-ray pencil makes it possible to calculate the angle between the actual initial portion of the track and the plane containing the pencil and the electric vector (δ) and the angle between that portion and the direction of the X-rays (θ). Statistical examination of values of δ and θ might then be expected to show most probable values of these angles and the existence of lateral and longitudinal asymmetry. Further, it would be possible to determine the three co-ordinates of any point on a track and therefore the true path of the β-particle in its flight through space.

In practice, adopting the Wilson mercury-lamp flash method of illumination and directing the illuminating beam almost horizontally on the line of the X-ray pencil, it was found that whilst ample light was scattered forward, giving good records in the horizontal camera, so little was scattered at right angles, that is, vertically, that the tracks were not recorded on the negative in the vertical camera. This difficulty was overcome by placing in the appropriate position on the base of the cloud chamber a right-angled glass prism and producing total internal reflection of the illuminating beam in a direction bisecting the angle between the axes of the cameras. Photographs so obtained were of satisfactory and approximately equal density.

Measurements have been made by low-power microscopic observation of the negatives directly and the advantages anticipated by the substitution of right-angle for stereo-photography realised. Using heterogeneous X-rays and moist air in the chamber, the existence of both types of asymmetry has been found. Experiments are now in progress in which homogeneous X-rays produce tracks in gases other than air.

ORRELL DARBYSHIRE.

Physics Department, Armstrong College,
Newcastle-upon-Tyne, August 19.

Spatial and Time Relations in Dreams.

IN NATURE of August 7, Dr. J. H. Kenneth refers to my letter which appeared in the issue of March 17, 1923, and he describes further observations of hypnopompic images.

In my letter I referred to an observation at the high-speed extreme end of the scale of time, in which the speed was so high that the image consisted only of blurred fleeting parallel lines, seen in an almost unconscious state. Curiously enough, after more than a year without any observations worth mentioning, I was enabled this very morning to confirm my statement that "the speed of succession (I ought to have said, of translation) of the images is an inverse function of the degree of wakefulness," by an observation at the other extreme end of the scale, thereby completing the series of observations necessary to establish the relation between speed and consciousness on a sound scientific basis.

I had just been roused from a deep sleep (the whole of the previous night having been spent journeying in a railway carriage, and therefore practically sleepless), I had exchanged a few words on the weather with the person who had awakened me, and I was therefore *quite awake*; I had closed my eyes for a few minutes before getting up, when, to my surprise and delight, an image at an *absolute standstill* appeared suddenly. The image represented a grassy rising slope with outcropping rocks, the details being so clear that, had time permitted, I could have counted the rocks; it lasted some eight or ten seconds before vanishing, and during that time it remained quite motionless. While observing its details I was fully realising that I was witnessing the process of unconscious mind-picture forming at the hitherto unobserved zero end of the scale, and verifying the relation I had expressed several years ago, and to which my attention had been again called by reading, last night, Dr. Kenneth's letter.

It is perhaps significant that, two days ago only, I was in North Wales and I had climbed the Moel Siabod (2860 ft.) alone, and therefore with my mind entirely free from diversions, and naturally concentrated on the orographic feature which had faced me during most of the time taken by the ascent, namely, up to the final steepest climb, a grassy slope from which emerged innumerable rocks.

I have used above the word 'mind-picture,' but it must be understood that such a hypnopompic image is quite different from a mind-image, as usually conceived, every detail of which is necessarily the result of an act of volition on the part of the person whose mind forms the image. A hypnopompic image appears as a whole, in all its intricacy of wonderful details, without any volition whatever. In the *Journal of the Society for Psychical Research* I have stated that the image seems capable of gradual modification at the result of volition, but on the whole my observations do not seem conclusive enough on this point, and it remains doubtful.

This study of hypnopompic images is not only very interesting, but it is also perhaps the only direct path of approach towards the elucidation of the *modus operandi* of the formation of an image by the mind and its perception as such, with all its minute details. Occasions in which such images come under reasoning observation are necessarily few and far between, and all students of psychology are greatly indebted to NATURE for keeping on record such scanty observations as are available, and which otherwise would be lost, or fail to fall under the notice, and awake the interest, of others.

The principal features of interest are, besides the speed relation referred to above, the possible simultaneous existence of several superposed 'films,' their variable inclination and the possibility of their snapping, referred to in my letter. Dr. Kenneth has established a most important feature, namely, the relationship between the inclination of the line of motion and the position of the observer, which I have so far failed to notice. I have forgotten the details of the observations described in my letter to which Dr. Kenneth refers, and I must therefore abide by my notes; these seem to imply the simultaneous existence of several films, superposed and at different inclinations, and this is at variance with Dr. Kenneth's observations. As the latter appear to be much more precise than mine, so far as this particular question is concerned, mine consisting but of one single instance, noted in passing, while my mind was concentrated on other details, I think that they should be given more weight, until my own observations are confirmed. Both states can possibly occur, according to circumstances.

M. E. J. GHEURY DE BRAY.

40 Westmount Road,
Eltham, S.E.9, August 22.

Pernicious Grafting.

THE question raised in a letter on this subject from Dr. Grabham in NATURE of July 17 is one of very real interest to horticulturists in Great Britain as well as to growers in Madeira. Examples of 'incompatibility' between stock and scion occur in practically all the commercial fruits which are propagated

by budding or grafting. Moreover, there is a very complete graded series, ranging from the case in which perfect harmony apparently exists between the two individuals, to that in which they are quite incompatible and no growth at all takes place. It may be, for example, that the dwarfing influence of certain stocks upon scions is the result of incomplete harmony. The phenomenon is more distinct in the case of stocks sometimes used for pears, upon which some varieties will grow perfectly satisfactorily for one or even two years, after which growth ceases and the plant eventually dies. A slightly different aspect of the matter may be observed in the case of plums, in which it is a matter of difficulty to induce the budded scion of some varieties to grow at all on certain stocks, and it should be emphasised that success depends upon both stock and scion. Whilst a variety which does not 'take' well on one stock grows quite satisfactorily on another, at the same time a stock which is unsuitable for one scion proves a good 'mother' to others.

It has been established at this Station that even seedlings which are closely related may vary considerably in their capacity to unite with a scion. The seedling Myrobolan plum stocks of commerce are an example of this variation. One Myrobolan seedling, for example, gives 95 per cent. success with buds of Czar plum, whilst another from the same batch gives less than 50 per cent. of satisfactory unions with the same variety. A similar range of variation exists within single groups of seedling stocks used for peaches; for example, the S. Julien group.

The problem is somewhat complex physiologically, and at present it is not even possible to state it accurately, although observations are now accumulating to this end.

From a practical point of view, there are two possibilities of circumventing the difficulty. Some pear varieties are incompatible with quince stocks, but a satisfactory tree is obtained by the process of 'double grafting' or 'intermediate grafting,' which involves grafting a compatible scion on the stock and regrafting the desired variety on the first scion a year later. There appears to be no reason why this method should not succeed with peaches.

A more certain method of avoiding the effects of incompatibility is to discover a stock which is suitable for the desired variety and to propagate that stock vegetatively. In this way the variation which is involved in the use of seedlings is obviated.

R. C. KNIGHT.
RONALD G. HATTON.

East Malling Research Station,
East Malling, Kent,
August 17.

THE ill effect which often follows the grafting of the peach on seedling stocks described by Dr. Grabham in NATURE, July 17, is very common in peach nurseries on the Western Frontier of India, especially when the peach is budded on the almond. In the summer of 1919, a few weeks before our service in Baluchistan came to an end, we paid some attention to this matter, the results of which are published in the *Indian Forester* of December 1919. We found that the restricted growth which often follows budding was due to imperfect sap circulation caused by an abnormal amount of callus tissue at the point of union between the stock and scion. Analyses of the peach leaves of affected trees in September 1919 showed that they contained less nitrogen, ash, phosphorus, lime, and potash, and much more starch, than normal leaves. Consequently root development was far below the average.

The trouble can be avoided (1) by ring budding the peach either on seedling peach or seedling almond stocks and (2) by destroying all weakly abnormal plants in the nursery before planting out. Ring budding is best done when the peach or almond seedlings are growing vigorously in the early summer. At this time a ring of bark, with one bud, is easily removed from the parent peach tree. This is placed in water and at once fitted on the cylinder of wood of the seedling stock, care being taken to push it well home and in contact all round with the living bark of the stock. Union is rapidly established and the peach bud begins to grow in about ten days.

The adoption of this method of propagation in Madeira, combined with the elimination of all abnormal plants in the nursery stage, would probably solve the difficulties described by Dr. Grabham.

ALBERT HOWARD.
GABRIELLE L. C. HOWARD.

Institute of Plant Industry,
Indore, Central India, August 9.

The Constitution of the Stars.

ON the theory of radiative equilibrium of stellar interiors, as developed mainly by Eddington, the assumption appears to be implicit that the density, mean molecular weight, and other contingent properties of stellar material, vary in a *continuous* manner from the star's surface to its centre. This assumption appears questionable.

Considering for simplicity a star consisting entirely of like atoms, it would appear probable that with the removal of each successive electron from the atom, due to increase of temperature with depth, or at least with the removal of all the electrons constituting each successive quantum-shell, abrupt discontinuities of state would occur comparable, in a general sense, with the separation of atomic matter into its phases.

The recent confirmation by Adams of Eddington's prediction of an abnormally high density for the 'dark' companion of Sirius may be held to prove that an assemblage of 'atoms' entirely 'stripped' of their electrons cannot result from a mere extrapolation of the laws of a perfect gas—or, for that matter, of any phase of atomic matter—to matter in this sub-atomic condition. Eddington's application of his theory of radiative equilibrium to stellar substance obeying the gas laws throughout makes the density at the centre of the star only 'fifty' times the mean density; it seems possible that 'fifty million' would be nearer the truth.

The suggestion is, then, that the central portion of every luminous star consists of 'stripped' atoms and electrons—or possibly in the earlier stages of its life-history at least of protons and electrons—surrounded by successive shells of atoms in various stages of association. As the density, so the pressure and temperature in the sub-atomic core of the star would be enormously higher than on the assumption of continuous variation, and, conjecturally, high enough to condition the building up of the more complex nuclei from the simpler, with the consequent conversion of mass into radiation.

The mean temperature, the effective temperature, and the absolute magnitude of the star would depend mainly on the mass of the central core, and would continually adjust themselves to its variation, so that stability would appear to be assured. But it is easily conceivable that for different stars the total mass may bear very different ratios to that of the central

core, in which case the output of radiation per unit mass of star would correspondingly vary. The view expressed by Russell and Jeans, that differences in this quantity depend on differences in amount of a hypothetical active material, is thus in accord with the hypothesis.

The question of reconciling it—or otherwise—with current views of the course of stellar evolution, is another matter which, if further consideration appears to warrant it, may be dealt with in a future communication. At present I remark only that it suggests an origin for stars in an assemblage of protons and high-speed electrons—the problem of whether and how these have a beginning lies deeper—and an unforced explanation for the occurrence of 'white dwarfs,' differing entirely from either of those proposed by Dr. Jeans or Prof. Eddington.

KERR GRANT.

Department of Physics,
University of Adelaide, July 5.

The Volatility and Dissociation of Borax.

KOLTHOFF (*J. Amer. Chem. Soc.*, 1926, **48**, 1447) states that he has been unable to confirm our statement (*Jour. Chem. Soc.*, 1925, **127**, 150) that fused borax loses sodium oxide. He reports that "even after the substance had been heated for two hours at 800° the weight did not change." His experiments, however, appear to be scarcely precise enough to prove that borax on heating (1) is not volatile, and (2) does not change in composition; as a matter of fact the volatility of borax at high temperatures is well established, having been observed by Hoskyns-Abrahall (*Jour. Chem. Soc.*, 1892, **61**, 650), Leonard (*Chem. News*, 1898, **77**, 104), and Smith and Van Haagen ("The Atomic Weights of Boron and Fluorine," *Carnegie Inst. Washington*, Publication No. **267**, 1918).

We would direct attention especially to the last-mentioned publication, where it is stated that "it is certain and not at all surprising that borax cannot be fused for any considerable time without loss" This evidence is so conclusive as to require no emphasis here. There is, however, another interesting piece of evidence. The inside of the silica muffle used for the fusions of borax in our investigation was completely coated with a white opaque enamel, about 0·06 inch thick, of a product of a reaction between the volatilised material and the silica. Clearly the salt had volatilised in some quantity, and with such a volatile substance, selective loss of the constituents could be detected only by analysing the residues We believe that the analyses given in our paper can only be interpreted to mean that borax on prolonged fusion leaves a residue poorer in sodium oxide than is required by the formula $Na_2B_4O_7$, and afford definite evidence of a preferential loss of sodium oxide.

H. V. A. BRISCOE.
P L. ROBINSON.

University of Durham, Armstrong College,
Newcastle-on-Tyne, August 10.

Photographic Theory.

IN the course of photographic investigations at the Royal Observatory, Edinburgh, it has been found by Mr. E. A. Baker that the initial stages of the photographic action, including the deviations from the reciprocity law, are calculable and well represented by assuming that the developable product is formed in two stages, each requiring one quantum; and that the product of the first stage returns in the absence of further stimulus to its original sensitive state, according to the usual law governing the progress of a mono-molecular change. In the case of process plates, where the grains are small and nearly uniform in size, the experimental results agree so closely with those deduced on this theory as to warrant the belief that the departures from it with fast emulsions, where not due to the reversal action, are to be accounted for by the diversity of grain size. The results of these investigations will be submitted to the Royal Society of Edinburgh during the coming session.

Experimental results for single layer fast emulsions and weak light are much to be desired in this connexion. The purpose of the present note is to express the hope that some of the researches at present in progress at different places may be directed to that end, and that results already obtained may be published.

R. A. SAMPSON.

Royal Observatory, Edinburgh,
August 13.

Kaufmann's Experiment and the Spinning Electron.

IN NATURE of August 21 Dr. L. C. Jackson quotes Wentzel as having supposed a *force*

$$(\mu[vX])/c \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

to act on a magnetic electron with moment μ moving with velocity v in electric field X (c is the velocity of light). He deduces from (1) that Kaufmann's experiment shows that the electron cannot have a magnetic moment as large as a Bohr magneton.

Wentzel, however (*Zeitschrift fur Physik*, **37**, p. 911), used (1) as *Storungsfunktion*, *i.e. energy*. (For an electron describing a periodic orbit in an atom energy

$$(\mu[vX])/2c \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

would, I think, lead to the correct first order perturbation, but the equations of motion are not of Hamiltonian form and (2) would not apply in general.) Thus Dr Jackson's argument rests on a mistake. His formula can be seen to be wrong dimensionally. 'He' has not the same dimensions as '$X\mu/c$.' In fact, extra force on a magnetic electron will depend on the gradient of the field. Kaufmann's experiment in no way precludes the electron from having a Bohr magneton of magnetic moment.

L. H. THOMAS

Trinity College, Cambridge.

Liver Extracts in the Treatment of Malignant Disease.

THE letter from Dr. J. R. Howitt in NATURE of August 21, p 263, appears to be based upon an extraordinary presumption. The liver, in early fœtal life, is large because it is an active blood-forming organ, but Dr. Howitt seems to suppose that it must have some endocrine function relating to growth. If this idea were correct, it would seem rational to presume that it was a growth-accelerating hormone, for the embryo is growing rapidly. Dr. Howitt seems to think that it is a growth-retarding or, at least, a growth-regulating hormone. That the method advocated may have clinical value is, of course, possible, but it is difficult to understand the theoretical basis of the treatment. I have no knowledge of decreased activity of growth in tumours when associated with enlargement of the liver due either to simple hypertrophy or to resumption of its blood-forming activity.

A. PINEY.

Institute of Pathology,
Charing Cross Hospital,
London, W.C.2, August 22.

Oceanic Isostasy in Relation to Geological Tectonic.[1]

By Sir JOSEPH LARMOR, F.R.S.

1. A CENTURY ago geodetic and gravitational universal surveys were mainly concerned with determining the effective (gravitational) ellipticity of the earth, after due allowance had been made for local anomalies, with especial view to the exact purposes of physical astronomy. One of the chief of these anomalies was exhibited by a remark of Airy, after scrutiny of the available data in his treatise (1830) on figure of the earth in the "Encyclopedia Metropolitana," that the observations show gravity to be abnormally in excess on island stations. It appeared, for example, that this cause might make the mass of the moon uncertain up to 2 per cent. A very refined explanation of this anomaly of island stations (which will be seen presently to be only partially effective) was offered by Sir George Stokes, from whom this last remark is quoted, in the course of a memoir,[2] fundamental for theoretical geodesy, in which he demonstrated that no outside survey could lead to any certain knowledge of the distribution of mass inside the earth, even in its outer crust, except as a matter of probability when backed up by geological knowledge.

It is explained there that the form of the sea-level must be locally depressed over a deep ocean, owing to defect of density; and in consequence on insular stations gravity at sea-level is measured abnormally nearer to the centre of the earth as a whole, so that from this cause its value is greater than that belonging to the mean spheroidal surface. In fact, the form of the ocean is an equipotential surface, including therein the potential of the centrifugal force of rotation in the familiar manner: but the part of the potential arising from the local water is abnormally small on account of its low density, and this defect must, in absence of local compensation, be made up by a greater potential of the earth as a whole, which demands depression of the local ocean surface towards the earth's centre.

The opposite result would arise from excess matter of an adjacent mountain or island peak: that would raise the ocean level in its vicinity and thereby indirectly diminish gravity, measured at sea-level as determined by levelling operations.

For example, at the centre of a circular oceanic basin or radius b and uniform depth h, its defect of potential would be with sufficient accuracy $\int \gamma\rho' h 2\pi r dr/r$, where ρ' is the defect of density of the water below that of the average terrestrial crust; thus it is $2\pi\gamma\rho' bh$, where γ is the constant of gravitation given by $\gamma E/a^2 = g$. Here $E = \frac{4}{3}\pi a^3 \rho$, ρ being $\frac{11}{2}$, is the mass of the earth of radius a. As the potential of the earth as a whole is $V = \gamma E/r$, this change of local potential, say δV_0, would be compensated by change of sea-level δh, where $\delta V_0/V = -\delta h/r$. Thus in the present case the fall of level relative to depth of ocean is given by the expression

$$-\frac{\delta h}{h} = \frac{a 2\pi\rho' b}{E/a} = \frac{3}{2}\frac{\rho'}{\rho}\frac{b}{a} = \frac{9}{22}\frac{b}{a},$$

while

$$\frac{\delta g}{g} = -2\frac{\delta h}{a}.$$

If the radius b of the oceanic basin is 50 miles this fall would be the fraction $\frac{9}{22} \cdot \frac{50}{4000}$ or $\frac{1}{200}$ of its depth; if the radius were larger it would increase in direct proportion until it is a considerable fraction of the earth's radius. A cup-shaped ocean could be similarly treated.

The steady sea-level would thus be depressed by $\frac{1}{10}$ of a mile owing to local causes, at the centre of a basin of 500 miles radius and 2 miles deep, in free communication with the other oceanic waters: and this approach to the earth's centre would involve increase of g measured at ocean level, given by $\delta g/g = -2\delta h/a$, or here $\delta g = 0{\cdot}05$ cm./sec.^{2}, where g is about 981, which is over one-third of the order of magnitude of the observed excesses at island stations.

But this explanation fails because there is a predominant offset. The vertical attraction of the local ocean regarded as an extensive flat slab of water is abnormally small by $2\pi\gamma\rho' h$, where $g = \gamma E/a^2$, that is by $g\rho' 2\pi a^2 h/E$ or $\frac{3}{2}\frac{\rho'}{\rho}\frac{h}{a}g$; thus this direct defect in g may be much the greater, being $\frac{1}{2}a/b$ times the indirect excess. There is however some effect in the other direction due to excess density of the local land, which is usually a substantial correction. This preponderance destroys and even reverses the Stokes explanation of the oceanic anomaly. Indeed closer examination shows that, as based by him,[3] rather confusedly as it seems, it depends on a potential equation used by Laplace which can, in limited manner, apply only to a locally infinitely thin spherical layer. The principle of depressed level became familiar, simple examples being worked out, *ab initio* and so correctly, by way of illustration in Chap. IV. of Col. A. R. Clarke's standard treatise on geodesy (1880), from the point of view however only of levelling operations, not of gravity.

But soon the discussion of the data of the Indian geodetic survey, by Archdeacon Pratt in India, revealed new features,[4] by showing strong residual defect of gravity on the Himalayas, such as could only be accounted for by a large defect of density underneath the mountains. Airy's idea that the mountains might be buoyed up by extensive roots floating in a denser magma, existing beneath a *thin* crust, could not of course now be maintained, at any rate in that form, in view of the high rigidity of the earth as a whole. But there was much to be said, on various counts, for a thinner and deeper viscid stratum, lying between the crustal material and the solid core, in which in the tendency towards equilibrium the pressure due to the weight of the crust must in course of ages have become

[1] Abstracted, with Sections 2 and 3 added, from *Proceedings of the Cambridge Philosophical Society*, Feb. 8, 1926.

[2] *Cambridge Transactions* (1849): reprinted in "Math. and Phys. Papers," vol. ii. Some idea of the great debt owed by the Indian and other gravitational surveys to the continuous amateur advice of Sir G. G. Stokes, spread over half a century of their development, may be gleaned from the collection of his "Scientific Correspondence" (Camb. Univ. Press), vol. ii. pp. 253-325.

[3] "Math. and Phys. Papers," vol. ii. p. 153. Stokes did not make any correction in this reprint in 1883; but Dr. Bowie states (*loc. cit. infra*) that there is no generally accepted explanation other than compensating excess of density beneath the ocean.

This analysis of Stokes in fact establishes as a general proposition that the effect of *distant* irregularities of surface mass consists of a direct vertical attraction, say g'', together with an indirect part due to change of level, equal to $-4g''$, thus countervailing four times: this influence, of wide range and presumably actually small, is superposed on the *local* effect here considered.

[4] In 1855-59: cf. A. R. Clarke, "Geodesy," pp. 96-98.

equalised laterally, at any rate partially, and the load upon it thus made uniform to that degree everywhere. It is implied that there are no local abnormalities of density in the core, which is reasonable as the core is probably metallic. This is the hypothesis of isostasy, propounded as a universal principle by Dutton and worked out systematically by Hayford and his colleagues of the American Survey, who found that it gave a fair account of the usually slighter anomalies (mainly of levelling) revealed in that great undertaking.[5]

Circumspection is, however, suggested in applying these ideas to the anomalies at oceanic stations; for the Stokes explanation already claimed to be an effective *vera causa*, without aid from compensation of density underneath. It happens that the subject is amenable in a general way to simple elucidation: and as the essential circumstances for submarine mountains and landscapes can perhaps be more directly estimated, it seems indeed to provide in some respects a closer test. On an ideal very narrow island-peak of negligible mass, in a wide ocean of uniform depth, with adjustment as a whole to general isostasy by denser horizontal strata underneath, there would be but slight resultant abnormality of the local part of the attraction. For the totality of the strata could almost be regarded as an extensive thin flat sheet, while local defect of potential on which change of sea-level depends would be still more closely compensated by the extra mass below.[6] Hence, in contrast to the Stokes uncompensated case above, under isostatic conditions gravity and level ought both to be regular over a wide ocean of nearly uniform depth with strata nearly horizontal underneath.

2. The distribution of gravity over an oceanic surface, beneath which local compensations of terrestrial density are taken to be complete, may thus be envisaged, perhaps most simply, by drawing a widely extended arbitrary horizontal boundary beneath the water, and marking out all above it up to the level surface as ocean separately compensated beneath, the law of depth of the compensation being for that hypothetical layer of the density of water unimportant. There will then remain the effect of the surplus of density, over the oceanic water, of the solid parts situated above this arbitrary flat boundary; and it is from this reduced submarine mountain-landscape alone, together with emergent peaks with density undiminished, and the nature of its compensation, that the amount of the actual local excess of gravity is to be estimated on the hypothesis of isostasy, the circumstances thus being analogous to those of a range like the Himalayas, but modified, as all the observations now belong to the same level near the tops of the submarine mountains instead of the bases. The nature of the compensation, in the deep-seated material, of this effective local excess load, would thus permit of being judged by itself; in particular, for steep submarine island peaks it is almost negligible, whatever varying distribution in depth be assigned to it, provided only it extends deep down, say towards the order of 10^2 kilometres.

The long-recognised excess of gravity at island stations was thus really evidence quite as forcible, and also as direct, as the subsequent records of Himalayan surveys, indicating that the defect of density of the masses of water is actually compensated, even over wide uniform oceans, at any rate to a very considerable degree, by excess of density below.[7] The systematic discussion of the level and gravity surveys of America, primarily by Hayford, has enlarged and forced into prominence the same very striking and surely fundamental type of conclusion, as extended even to the usually smaller and less abrupt anomalies there revealed.

The evidence, then, is on all sides remarkably strong, that with increase of depth the terrestrial material gradually becomes softer, so to say, possibly owing mainly to rise of temperature, down to a limit which perhaps at an outside estimate may approach 10^2 kilometres: that below some such depth the mass of the earth presents again a perfectly solid, though doubtless elastically deformable, foundation on which the softer strata directly above have flowed gradually in the course of ages towards an equilibrium nearly hydrostatic, depending in detail, however, on the distribution and range in depth of the softness, in a way that is scarcely much amenable to scrutiny. To effect such adaptation, the displacement of deep-seated material need be only over slight distances, unless the yielding layer is thin. An unyielding foundation underneath is essential to any approach to local isostasy; the earth as a whole must be solid, as it is known to be for dynamical reasons. As regards the relatively shallow upper terrestrial layer which thus becomes viscous with depth, in a way not necessarily uniform nor to the same depth everywhere, the question of rupture or damping of transmission of internal earthquake tremors in crossing these softer layers arises, and is probably ripe for discussion; such a stratum may of course be even completely yielding for slow secular stress while thoroughly elastic for the rapid alternations in seismic oscillations. It is to be remarked, however, that as a result of theory superficial travelling waves, at any rate on uniform elastic material, could scarcely arise from other than a superficial cataclysm, secondary it may be, so that purely superficial seismic undulations would have to come from sources located within their own quite small range of depth. But the velocity would change (dispersively) with wave-length, and this conclusion may be modified, as Prof. Love pointed out, if the elastic quality or density, instead of being uniform, changes notably within the depth of a wave-length.

Why distinct settlement of the strata towards isostasy such as is thus variously confirmed should be necessary at all, affords direct scope for fundamental tectonic speculation, of an interest quite apart from geological detail. Is this abnormally small density beneath mountain ranges due to higher temperature or to lighter material? How could such locally varying temperatures have become established over a consolidating earth? If the height of the mountains is determined largely by the defect of density beneath, they must to that degree have been pushed up hydrostatically from below rather than elevated by lateral stresses; yet folding of the mountain strata is con-

[5] Cf. the chapter in H. Jeffreys' recent treatise "The Earth."

[6] In the case illustrated above, with radius of ocean about 500 miles and depth of compensation 100 miles, about 10 per cent. of the anomaly both of attraction and of potential would remain after compensation of the ocean.

[7] For recent special estimates see a note by W. Bowie, *Proc. Washington Acad.*, Dec. 1925.

spicuous. Subsidence towards isostasy might perhaps induce folding to some degree. If the depression of the Pacific Ocean is thus determined in the main hydrostatically, is there not less room for the cosmic theory that it may represent the cavity from which the moon was originally shed away?

3. *Postscript.*—One observes that these and cognate questions, insistent and fascinating, form the subject-matter of Prof. Joly's recent path-breaking book, "The Surface History of the Earth," which invokes steady evolution of heat by radioactivity of the rocks, interacting with isostatic influences, as the cause of periodic outbursts of surface activity which have fashioned the existing features. There are to be compared the views developed in H. Jeffreys' recent comprehensive treatise, "The Earth." For a condensed account over an extensive range *cf.* "A Symposium on Earthquakes," by F. A. Tondorf, N. M. Heck, W. Bowie, A. L. Day in *Journal Washington Academy*, May 4, 1926, pp. 233-254 (also more recently G. R. Putnam). In a less special way, such questions have been prominent since the treatise of E. Suess on the earth's surface features. There is also the problem of the time-scale of development, projecting into vast æons of the past, yet with clues arising mainly from the fossil traces of the succession of forms of life.

A few special remarks may be significant here.

It appears that the lag in compensation of accumulating great depths of sediment is but small, compared at any rate with the time of accumulation, for the compensation is always well advanced.

Tidal pulls on these adjustable surface-sheets would on Newtonian principles be differential, and so extremely slight. Thus even the extreme case of an elastic earth surrounded by an ocean of molten lava of the order of 10^2 kilometres in depth, in which continents would be analogous to ice-sheets and mountains to icebergs, is not unthinkable dynamically, however it be thermally; though the existence of the actual oceanic tides would demand a rigid and deep crustal layer.

But even if the lagging tidal pull were large enough, it could only cause a westward drift of the fluid surface material around the earth as a whole, not of continents and mountain ranges floating thereon. For the principle of Archimedes asserts itself; as regards the uniform field of force the floating mass can be replaced by the magma which it displaces, up to the level surface; thus it is the same as if the tidal forces acted on a uniform sheet of magma without surface excrescences and no differential drift could arise—except in so far as a uniform drift may be obstructed or deflected locally by the more solid roots of the floating continents that are carried along with it.

The earliest table-lands, of primitive rock, must have been pushed or floated up, and to great heights; it would appear from the literature that their subsequent denudation by aereal influences accumulated stratified deposits along the coasts of the oceanic hollows, which gradually sank into the magma by their own extra weights, perhaps most in the middle so as to curl over by the lateral pressure,—themselves sinking down while the adjacent denuded high land is floated up, until by accumulation combined with sinking, and helped by effusions from below, they attained to considerable slopes and great thicknesses, even five miles or more, that then somehow they were pushed up again bodily, yielding after repetitions of such processes folded mountain-ranges of stratified rock such as geologists know, the primitive elevations having passed largely out of sight. At any rate nothing more plausible seems to have been hitherto thought of.

The Golden Eagle.

By SETON GORDON.

"Thrice the age of a dog the age of a horse,
Thrice the age of a horse the age of a man,
Thrice the age of a man the age of a stag,
Thrice the age of a stag the age of an eagle,
Thrice the age of an eagle the age of an oak tree."
—*Old Gaelic saying.*

THE golden eagle is the most magnificent bird of the Scottish highlands. Up to the middle of last century, the erne or white tailed eagle shared the cliffs of the western seaboard and islands with the golden eagle, but the erne is now extinct, although so late as the middle of the last century almost every headland of the Isle of Skye had a pair of these fine birds nesting upon it.

The flight of the golden eagle has inspired many poets, and from the earliest times it has been looked upon as lord of the air. In the Book of Proverbs we read:

"The way of an eagle in the air,
The way of a serpent upon a rock,
The way of a ship in the midst of the sea,
The way of a man with a maid."

These, says the writer, are the four things too difficult to understand. Keats wrote in 1818 "Eagles may seem to sleep wing-wide upon the air," and how descriptive are Wordsworth's lines "Faint sound of eagle melting into blue." Scott writes that the eagle from her rocky perch on Ben Venue "spreads her dark sails to the wind."

The eagle is the royal bird of Greek mythology; an eagle of gold was the standard of the Romans. At least three countries have the eagle as their emblem: Assyria, Persia, and Rome. It is, or was, the national arms of France, Germany, Russia, Italy, Austria, and Poland.

At the present day the golden eagle is confined to the central and western highlands of Scotland. In the more accessible districts it is terribly harried by egg collectors, and here very few eyries escape. It is unfortunate that the golden eagle, almost alone among Scottish birds, should never lay a second time in a season, even if its first clutch of eggs be taken when quite fresh, but, despite the egg collector's zeal and the keeper's gun, I do not think the eagle is on the decrease, except here and there. Each pair of eagles has two, sometimes three, eyries. The same eyrie is seldom used two years in succession, because the eaglets remain long (about eleven weeks) in the nest and from

the accumulated remains of prey the eyrie becomes foul towards the end of the time and needs more than a twelvemonth to be thoroughly cleansed by winter frost and summer sun. Some of the Scottish eyries have been used regularly for at least half a century, and probably much longer.

The nesting site may be a tree or a rock. In the central highlands a tree is frequently chosen, and I have seen nests in a Scots fir, and, rarely, in a birch. In her choice of nesting material the golden eagle is most particular. The eyrie may be from six to eight feet in diameter, and the crown on the nest is composed entirely of green fir branches (if there are any fir trees in the district), which the eagle breaks off the trees with her powerful bill. Near one eyrie that I know of a solitary fir grows, and each spring the eagles fly to it and strip it of some of its branches. The lining of an eyrie is, when possible, always made of the great woodrush, *Luzula sylvatica*.

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FIG. 1 —The hen golden eagle preparing to feed the family.

Eagles build early, and I have seen a large branch being carried to the nest on January 27. In the more sheltered nesting-places the eggs are laid in mid-March, and the eaglets hatch between April 29 and May 1.

It is not known whether the cock bird takes his turn at hatching the eggs. In April of the present year I was watching an eyrie when the male bird flew up the corrie and settled on a branch a few yards from where his mate was brooding her eggs. I hoped that I might witness the 'change over,' but, after apparently satisfying himself that all was well, the cock shook himself like a dog (there had been a heavy hail shower a few minutes before), spread his great wings, and was gone from my sight.

Although the golden eagle usually lays two eggs, she frequently rears only one bird, and there is no doubt that one eaglet sometimes kills the other. Last season my wife and I built a hiding tent thirty feet from an eagle's eyrie, and spent between two and three hundred hours in it photographing and observing the home life of the birds. As usual, one eaglet was a hen, the other a cock. In birds of prey the female is the larger, and when the eaglets were ten days old there was a marked difference in size between the two. During the early days of their lives the young hen frequently drove her brother round and round the eyrie. The attack was always entirely unprovoked. Sometimes when the cock eaglet was lying asleep in the nest his sister rose and walking unsteadily over to him aimed a deliberate and vicious blow at him. Fortunately for him the young cock was the quicker of the two on his feet, and I am convinced that on more than one occasion his superior speed alone saved his life. Each time his sister pecked him she tore out much of his down, until the eyrie and the heather around were strewn with this white down. The victim never once retaliated; indeed he was a miserable young person at this stage.

Sometimes, after almost exhausting herself by her attacks on her unfortunate brother, the aggressor stood up unsteadily in the eyrie and flapped her downy wings (her feathers had not as yet commenced to grow), uttering as she did so a wild yell of defiance. It was a weird and very extraordinary cry, and I shall never forget it. Once the mother eagle returned in the midst of this bullying and calmly watched the down being torn from her unfortunate son. Perhaps she thought it better that he should be brought up in a Spartan school.

This pair of golden eagles brought to the eyrie a varied collection of prey for the youngsters. Blue hares, grouse, and ptarmigan were brought regularly, and, more astonishing, the birds hunted squirrels and brought them to the nest. Although the eyrie was in a deer forest no red deer calves were brought, but two roe deer calves were carried up to the eyrie from the low ground. My wife had the good fortune to

be in the 'hide' when one of the calves was brought. The calf was minus head and entrails, and even then its weight was such that the cock eagle had to rest several times upon trees on his way to the nest. He

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FIG. 2.—Cock golden eagle tearing up a hare for the eaglet.

was carrying the calf in one claw, and when he arrived he threw down his burden and stood breathless at the edge of the nest. The eaglets were filled with excitement, and the young hen pounced upon the calf with the same weird yells of triumph she had uttered after her fierce attacks upon her brother. The latter picked up a feather from the floor of the eyrie and dashed about holding it in his mouth!

The cock eagle was a magnificent bird. He was smaller than the hen, and his plumage was lighter than hers. He was dashing and debonair; the gleam of his eye was magnificent, and he was a true king of the hills.

One sunny afternoon the interior of the 'hide' was so stuffy that I put my head half out of the entrance to get a breath of air. Against the blue of the sky I saw a small black object which I thought at first glance was an insect. But with incredible speed the dark speck grew in size until I saw that it was the cock eagle rushing down towards the eyrie from the high snow-streaked corries above. He was travelling like a thunderbolt. In one claw he held a ptarmigan, and this extra weight no doubt increased his speed. I suspect that I shall be accused of exaggeration when I say that his speed was at least two hundred miles an hour, but I am convinced that this is no over-statement. I have seen nothing in the bird world to equal that splendid downward rush, and to see it was worth many hours of patient watching.

Regularly about three o'clock each afternoon the cock eagle arrived at the eyrie from his hunting. In the eyrie he laid his prey, and, after looking at his yelping brood for the space of about a minute with indifference, he spread his great wings and sprang into space. On these occasions his mate must have been watching him from a neighbouring tree, for almost immediately he had left she glided down to the nest and fed the family on the prey he had brought.

When the eaglets were small there were days of wild west wind, when the squalls of hail pattered like small shot against the sides of the 'hide.' The eagle's tree rocked in the wind, and the mother eagle, as she guarded her young after having fed them, swayed gently to and fro, balancing herself with all the skill of a sailor when his ship is meeting heavy weather. The young hen eagle left the nest early in July, but the cock, being more backward (partly, no doubt, because of his ill-usage in his early days), was not ready to follow her. For some days the parents fed him in the eyrie, but then seemed to decide that he was ready to leave. Each day they brought him less food, and at last the eyrie was bare. The parents were starving him, and daily he became weaker and constantly

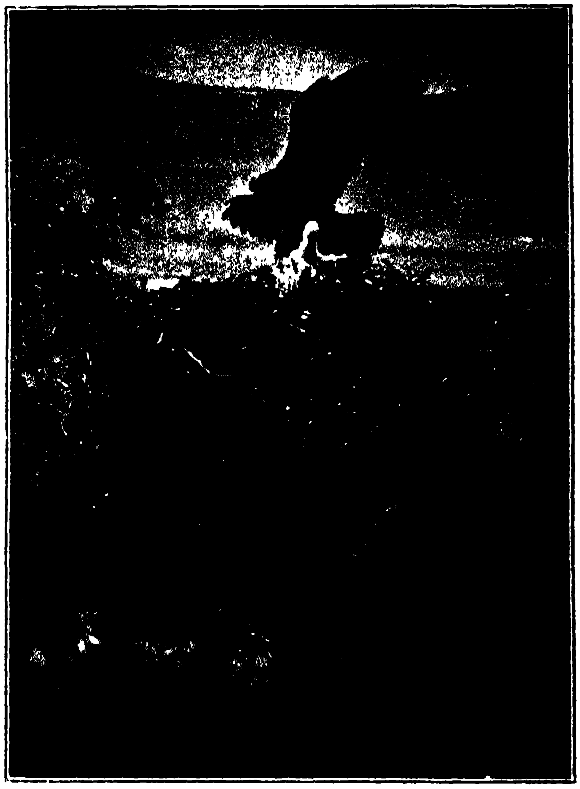

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FIG. 3.—The cock golden eagle brings in a rabbit.

scanned the skies for his father or mother. He practised wing exercises repeatedly during these days, and also practised 'grabbing' exercises with great ferocity. At last, on July 16, the eyrie was vacant—starvation had compelled him to take his first flight, the biggest step in his young life.

The Regional Balance of Racial Evolution.[1]

By Prof. H. J. FLEURE.

THE Oxford meeting of the British Association naturally recalls to one's mind the famous controversy about evolution, the fact of which is now universally accepted despite little outbursts where old modes of thought survive on the fringes of civilisation. The application of the idea of evolution to the study of mankind has been carried very far, and we have especially Elliot Smith's recent summary with its emphasis on correlated improvements of eyes, brain, and hands. I shall not venture upon the ground so well covered by one of our greatest leaders, but shall merely add a few points necessary for my main purpose, which is an attempt to outline the field of research into the distribution of the characteristics of modern living men.

First may be mentioned the very probable, not to say certain, lengthening of pre-natal life from about 220 to 280 days, with consequent continuance of growth of brain and delay of hardening of frontal and facial elements and the passing of the stage at which hair was previously developed now under new conditions conducive to the maintenance of embryonic, downy hair (lanugo), rather than to the growth of the definitive hair. Thus the lengthening of pre-natal life seems to have been an important factor in that reduction of hairiness which is a feature of mankind. It has also contributed to the increase of skull volume and of consequent difficulty in head support, so that infancy and opportunities for lengthened maternal care have been prolonged. The postponement of fixation of characters, the maintenance of more or less embryonic conditions with resulting unfolding of new features in response to opening up of new possibilities, has thus become a cardinal fact for the human race.

The prolongation of infancy has also contributed to differentiate women's work from men's work, and it may well have accompanied the growth of the hunting habit in man; woman remained more a gatherer. This differentiation increased personal relations and gave two mutually supplementary types of food, doubtless a valuable step forward at that stage of evolution. The consequent enrichment of social life is an obvious fact, but in mentioning this one must emphasise that human society does not so much result from the coming together of individuals as that human individuality results from the liberation, bit by bit, of individual initiative within groups.

The stone implements of early Pleistocene man are generally of a few types only, though they may be wonderfully executed. The heavy hand of tradition has often limited initiative, but also often allowed the compensation of the craftsman's joy. Mid-Pleistocene man, at least, seems to have made ceremonial burials and thus, perhaps, to have begun to dream of a future life. It is with the Aurignacian phase, or the beginning of the late Pleistocene, or, to use another name, the beginning of the neanthropic period, that we note a great liberation of initiative, and it is from this phase that we have the earliest assured evidence of modern types of man, so far all or almost all from the north-western quadrant of the Old World.

Efforts have been made to estimate the climates at which men's bodies and minds function best and to argue thence to the home under the conditions of which they became men of modern type. The best conditions for bodily efficiency are not very different from those of our present British climate, for mental efficiency they are like those of our cooler (but not too bitterly cold) spells. Olbricht has ventured the suggestion that there was probably a big mental advance during a cold period such as a late phase of the ice age; but at such a time a climate like our present one favoured the south Mediterranean and the belt from the Sahara to Mesopotamia, perhaps only this belt. This belt seems to give abundant evidence of inhabitants of, possibly, mid-Pleistocene date.

We may venture provisionally to place the early modern men in the zone from the Atlantic edge of the Sahara to Persia, and should think of a fairly large population not all exactly alike. What sorts of men were they?

They may have been more or less brown-skinned with blackish hair and brown eyes, with jaws and brow ridges much reduced from the conditions known in many of the earlier forms of man, with heads almost balancing on the vertebral column, but the erect posture not yet attained in all cases.

The well-known youth and old woman from the lower layers at the Grotte des Enfants, currently known as the Grimaldi type, were short, with broad noses and strongly projecting mouths, but without brow ridges. Their heads were long, narrow, and high. They have often been said to be negroid, but it would be wiser to say that both in them and in many living Africans we find some of the same characters.

The name of Cro Magnon has often been used as a label for nearly all the types of the late Palæolithic except the Grimaldi skeletons just mentioned. Giuffrida Ruggeri urged a more restricted use of the term, but his views were held back from general acceptance for a while owing to exaggerations due to Klaatsch, exaggerations which Klaatsch retracted before he died. Using the term more carefully and more strictly, it applies fully to about four skeletons and partially to two or more of presumed Aurignacian date as well as to other later ones. In the Cro Magnon type the head is long absolutely, but only moderately long relatively, the cephalic index being about 74, 75, or 76. The height of the skull is much less than its breadth, the nose and chin are strong and narrow, the brow ridges do not stand out separately in front of the forehead, the stature is great, the cheek bones are large and project laterally, and the face is short and broad.

It is difficult to accept either the Brünn or the Brüx calotte as suitable objects from which to name a race, and there are difficulties about naming it from the Combe Capelle skull. We await anxiously the full description of skulls found at Predmost. The general characters here are extreme length and narrowness of the head, so that the cranial index is rarely so high as

[1] From the presidential address to Section H (Anthropology) of the British Association, delivered at Oxford on August 9

73 on the skull; the height of the skull is usually greater than the breadth, the brow ridges are well marked and in this connexion the rather exaggerated term 'Neanderthaloid' has often been used. There are a few skulls otherwise belonging to this type which are low in the vault.

Skulls from Solutré show high heads without strong brow ridges, but heads which are so much shorter as to make the usual index 78-83. We await confirmation of the date and detailed descriptions of the Solutré skulls.

Reviewing these early skulls comparatively, we notice that great length of head is a very general feature. This is combined with a very narrow and rather high-ridged form in some cases, and a less narrow and less high-ridged form in some others.

The great majority of the apes and the extinct types of man do not seem to have been relatively long-headed, if we are careful not to include the enormous brow ridges of some of them in measuring the head length. Comparing the skulls of Aurignacian men with these others, we note a marked growth in length, especially in front of the ear. This implies special additions along the coronal suture. Now the temporal muscles were of very great importance to the flesh hunters of the late Palæolithic age, who doubtless had to tug at flesh food. They had been important, no doubt, in earlier times as well, so they may be looked upon as an ancient feature persisting for a while and exerting an influence on the new growth. The early closing of the sagittal suture gave a firm anchorage to the temporal muscles and limited growth in breadth anteriorly at least; increase of anterior space must thus be secured mainly by increase in length. It is therefore permissible to suppose that a great lengthening, extreme in some cases, was a feature of skull growth among most, but not necessarily among all, early representatives of modern types of man.

In several cases the two sides of the skull roof seem to have been pulled down, or in other words the sagittal line was ridged up, and this is found frequently associated with a deep temporal hollow, so that the brow ridges are left outstanding. In other cases the temporal muscles seem to have pulled the sides down to a lesser extent, and the head is less narrow and the brow ridges less outstanding. Lest too much importance be attached to the pull of the temporal muscles, it is well to remember that the face was still heavily developed in most early examples of modern man, and that to balance this the head tended to grow so as to project backwards, *i.e.* to grow in length.

It is thus possible to think that in the evolution of modern men we may have:

(*a*) Types with little of the additional growth just mentioned. These would be sub-brachycephalic and small.

(*b*) Types with considerable growth, almost entirely growth in length, and with the sides of the skull sloping steeply from the sagittal ridge. These would be hyperdolichocephalic and usually high-headed, often with strong brow ridges.

(*c*) Types with considerable growth in length but without the sharp down slope of the sides. These would be more moderately dolichocephalic than (*b*), less high-headed and usually with less strong brow ridges.

(*d*) Types with considerable growth more generally distributed along the various sutures. These would be mesaticephalic or sub-brachycephalic with parietal rather than frontal breadth as a distinguishing feature.

I think it useful to figure the great lengthening as a feature in the main groups of early modern men in the early home zone, and then to think that there were fringing groups who remained without this lengthening. These fringing groups on the hot south side, probably subject to unfavourable conditions, would have relatively small growth and would remain as small mesaticephals. On the cooler north side they, then or later, were able to accomplish longer continued growth and so gave better grown, larger headed mesati- and sub-brachycephals.

The first group seems illustrated by the Andamanese, Semang, Aeta, Tapiro and other pigmies of south-eastern Asia, and the Akka and other small peoples of equatorial Africa, the last being much less strongly pigmented than the others. All have flat, broad noses, the Tapiro less than the others. It seems almost necessary to think that some of these types have left their mark on the population of various parts of India, and some of their characters seem to survive also among various African peoples other than the equatorial pigmies. The Bushmen, on the view here sketched out, would be types showing some measure of head lengthening, and the Tasmanians also.

I have not mentioned hair. The downy hair has fairly straight roots even in Bushmen, and the spirally curved hairs so characteristic for Africa develop that curve with a sharp angle between it and the root. As ape hair also has fairly straight roots, it thus seems likely that spirally curved hair is a specialisation among some early types of modern man, chiefly, I think, types on the south side of the early home zone under hot conditions, where hair reduction and the pressing of the roots up toward the surface would allow the freer giving off of heat.

Next we may think of cases in which head lengthening had taken place fully. Broom's Hottentots and Koranas fall here, and so do most of the African peoples. Among some the pressing of the hair roots up to the surface has made possible a large growth of blood vessels in the skin, and the reduction of hair has gone very far in certain cases. The thin supple epidermis without many dry non-conducting layers, the everted lips, as well as the development of skin blood vessels and the reduction of hair, all promote cooling.

It was mainly types with broad, flat noses, prominent mouths, feeble brow ridges, and spirally curved hair that drifted southwards in Africa, from the south flank of the early home zone, but a brow-ridged type also went that way.

The south-eastward drift was a drift rather from the end than from the flank of the early home zone, and for this reason it was more varied. Pigmies with spiral hair and medium broad heads; dark Tasmanians with spiral hair and partly lengthened heads; south-east Australians with lengthened but often low heads, dark colour, and wavy hair; North Australians with lengthened and high heads, dark colour and wavy hair; Papuans and Melanesians with long high heads, dark colour, and spirally curved hair and so on— an interesting series of drifts through a long and relatively narrow

belt. This contrasts with the African drift through a wide belt lying on the south flank of the early home.

Let us turn now to the northern flank of the early home zone and think of migrants across from Tunisia to Sicily and Italy, migrants mostly with very long heads, the bearers of Capsian culture to Europe. In addition to these we have to think of people drifting northward between Elburz and Hindu Kush as the ice diminished. Once north of this barrier the human drifts could spread either north-eastwards in the lowlands or north-westward to the European loess. These early drifts have been pressed upon by subsequent streams and their survivors are now found in peripheral situations and in a few refuges on the way. Survivals of these early characters are shown in types found at Plynlymon. The new work on blood constituents is interesting in that it is tending to show that the blood of the peripheral, longheaded peoples is inherited with little alteration from a phase before certain specialisations occurred in the composition of the blood of many human stocks.

When the belt of the westerly winds from the Atlantic shifted northward as the ice sheets diminished and the land sank in north-west Europe, inner Asia lost its rain to a large extent, but melting ice seems to have kept it moist for some millennia. Mesopotamia remained moist for the same reason for a good while. The change of climate in north-west Europe produced a human crisis: the spread of the forest broke the old schemes of life, especially as the first phase was that of a pine forest, very unfriendly therefore to man. In south-west Asia, wild barley and possibly wild relatives of wheat have been found. Somewhere then, probably on the northern fringe of the early home zone, there arose sooner or later a culture complex, including cultivation of wheat and barley, the art of stone grinding perhaps developed through the use of stone for digging, the consequent invention of the stone wedge, and so the rise of new power over wood to haft tools, to make palisades that kept animals under man's command for milk, etc., the making of pots, the dawn of metallurgy and so on. I think of this complex, provisionally, as spreading among hill folk rather than plains-men, for the latter might more easily keep up their old habits of following herds of animals, and it seems that it spread through Anatolia to Hungary and so, after a long history, ultimately to western Europe probably about the end of the fourth millennium B.C. There is, however, no need to picture the awakening west as copying exactly from old and distant cultures.

The mastery of a wood technique, food production, and the potter's art all helped home-making and the provision of soft food for infants, delaying the hardening of the skull or, in other words, prolonging infancy. In this connexion one pictures diminution of jaws and brow ridges and freer growth of the skull along many sutures leading to a maintenance of the mesati- and sub-brachycephalic skull form. This form and the brachycephalic form, which I believe is derived from it, are mainly characteristic of the great mountain belt of the Old World.

Another factor that enters into the story here is the probable increase of chewing at the expense of tugging, and Prof. Thomson and others have associated with this an increased width of the malar bones to which the masseter muscles are largely attached. Increased width of face and jaws is likely to have encouraged increased width of head as well. It is important to note that there has been no suggestion that some functional change in the jaws led to a transformation of dolichocephaly into brachycephaly. The suggestion is rather that the brachycephals have originated from fringing mesaticephals or sub-brachycephals. I appreciate and accept Prof. Thomson's observations and views on the lower jaws of the typical broadheads. These thoughts make me incline to criticise our present use of terms for skull forms.

Brachycephals give one the impression of evolution and drift from Anatolia and surrounding regions. It is noteworthy that Pamir broadheads are much like Alpo-Carpathian and Cevenole. For the present, I look upon the extreme broadheads of the high plateaux of east central Asia as showing in some cases a flattening of the nasal bones and an insinking of the nasal chambers, but others have the profile prominent enough. The broadheads of the high plateaux have yellow-brown skin, the early brown being retained and the yellowness being increased by the insinking of blood vessels, and the thickening of the dry superficial layers—both protective devices in a region of intense winter cold. The very variable extra fold of the upper eyelid may have begun as a consequence of the facial flattening, and once developed would be a valuable protection against glare.

The well-known diagram of Ripley shows the distribution of broadheads in Europe as known in his day, and its relation to the mountain zone is very marked. A preliminary attempt has also been made to design a map of types in Europe. Around the mountain zone the broadheads have spread and the longheads are mostly peripheral in the north-west and in the south-west. In the north-west, climate encouraged long continuation of growth and diminution of pigment, and I look upon the tall fair Nordic as to a large extent a regional specialisation. In the south-west the Mediterranean type links on to the Hamitic type of North Africa and the longheads of the Arabian wastes, all having among them an element surviving with little change from the early days of modern man, but many showing somewhat more general growth along the various sutures, and therefore less extreme length of heads. The fundamental element of the British population I look upon as drifting from the continent in late Palaeolithic times, with a southern element fairly well represented but, nevertheless, on the whole neither fully Mediterranean nor fully Nordic, but, as I think Sir Arthur Keith would say, just British.

I have tried to suggest that development of the individual depends on hereditary factors of a conservative nature, and on environmental influences which have changed with climate, food, and equipment. Thus they have affected plastic infancy, and in the end have moulded race types blending hereditary characters sometimes brought from afar with other features in which the changes of environment have had more power. A doubt persists in my mind as to the assignment of more than a somewhat limited value to taxonomic treatment of the question. It seems

worth while to think rather of regional gatherings together of physical characters.

Changes of environmental influence are usually cumulative, for natural processes are essentially irreversible even if, as in climate, there is something of a cyclic scheme of change. The cumulative change may be said to draw out the course of development more and more from its original path, thus creating a state of internal strain. No two embryos are exactly alike, and in some the hereditary units may vary towards, in others away from, a condition which would diminish that internal strain. Those varying so as to diminish the strain would probably grow best. So we have a theoretical possibility of variation of the germ limping after variation of the soma. In the case of man, whose development is so closely linked with varying balances of the influence of endocrine glands, the adjustment of the variation of the germ to the variation of the soma may not be very slow.

A special attempt has been made to suggest the part played by the development of social life in the evolution of human physique, and the importance of parental care. These factors seem in particular to have led in certain circumstances to a vast liberation of individual initiative within our human societies, especially after the development of intercourse between groups.

We must speedily undertake more and more biological observation and measurement among ourselves, and we must exercise ever more care in the treatment of our measurements. Averages of cases which are not properly homologous should not be made lest we mask the biological truth in mathematical abstractions. If our anthropological work can but go on becoming more biological, gaining insight into physiology, especially of the brain and the endocrine organs and their correlations with growth, I venture to think that racial study will develop great practical value for education, for the fight against tuberculosis and other diseases, and for race-improvement. Evolutionary race biology seems to be a hopeful sphere of work that may bring about a much-needed enrichment of public opinion on social questions, a diminution of race-arrogance, and a check on schemes that do not sufficiently allow for the mutual adaptations between diverse human stocks and diverse environments. I would ask for faith in the future of such work to bring out its great possibilities for nobler races with freer personal initiative in societies both more stable and richer in the things that are not seen.

The London School of Hygiene and Tropical Medicine.

HYGEIA, the goddess of health, daughter of Esculapius, was included among British *lares et penates* some fifty years ago, when the Public Health Act of 1875 was adopted. Since that time Great Britain has been a world pioneer in the achievements of its public health service. Attention was concentrated in the earlier years on drains and sanitation, but gradually the scope of the work of the public health authorities has widened. The results, as seen in the reduction of the death-rate to 12 per thousand and the consequent increase in the span of human life and in the health and happiness of the people, have undoubtedly had a bearing on industrial efficiency and national prosperity. But much remains to be done. Official evidence before and during the War relating to national physique and the statistics of diseases indicate the need for sustained effort in the health crusade. Even the layman can form some conception of the vast field for scientific research from the wonderful discoveries of which information is published from time to time, such as those relating to the curative power of natural and artificial sunlight and chemical methods of preventing goitre.

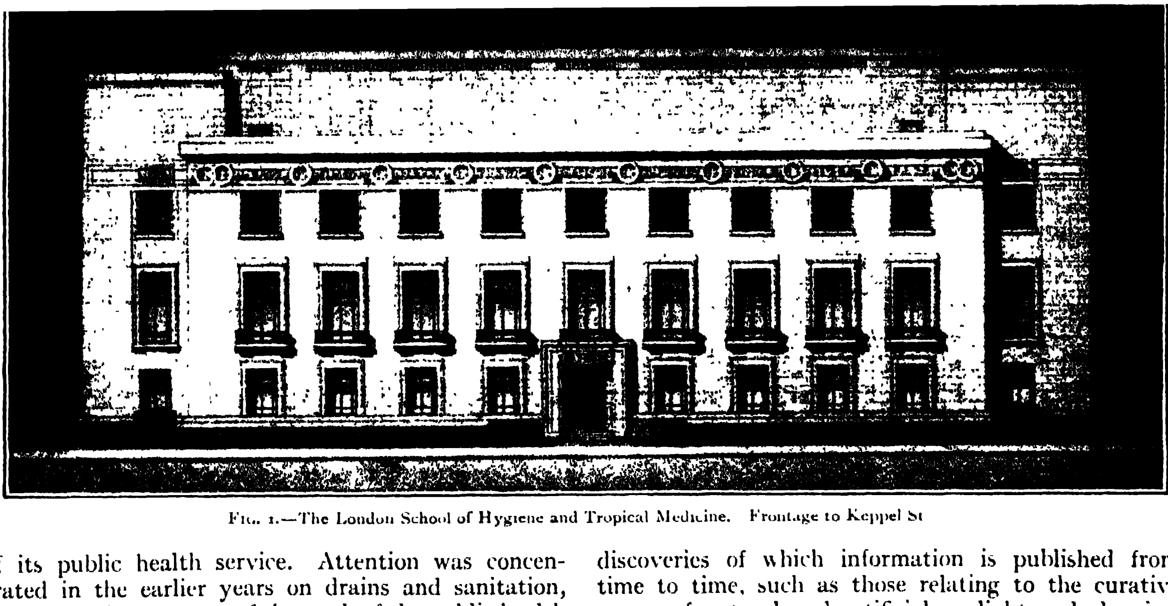


FIG. 1.—The London School of Hygiene and Tropical Medicine. Frontage to Keppel St

The Ministry of Health, as in duty bound, early recognised the need for extending facilities for instruction and research in preventive medicine. A committee appointed by the Ministry and presided over by the Earl of Athlone submitted a report in

May 1921 advocating the establishment of a post-graduate medical school in London and also an institute in State medicine. An expert committee was afterwards appointed to consider the recommendation as to a new school of hygiene. Financial difficulties, which may well have appeared insuperable, were miraculously removed by the generous offer of the Rockefeller Foundation to provide two million dollars (400,000*l.*) towards the cost of the building, on the understanding that the Government would accept the responsibility for maintenance, the cost of which was estimated at about 25,000*l.* a year. The appointment, in October 1923, of Dr. Andrew Balfour as director enabled definite progress to be made in the planning and organisation of the new school, the foundation stone of which was laid by Mr. Neville Chamberlain, Minister of Health, on July 7.

Such is the brief but honourable history of an enterprise representing one of the most important educational

FIG. 2.—The design of the seal adopted by the London School of Hygiene and Tropical Medicine owes its inspiration to a coin of ancient Sicily, believed to have been struck to celebrate the deliverance of one of the cities from a pestilence caused by the stagnation of the waters of the river. The design shows the deities Apollo and Artemis proceeding slowly in their chariot, Artemis driving while her brother, the sun-god, discharges arrows from his bow. The arrows are the healing rays of the sun, which drive away the malaria mists; and Artemis is beside him as the goddess who eases the pains of women labouring with child. The fruitful date palm has been added to symbolise the tropical side of the work, and at the foot is the serpent staff of Esculapius.

and scientific developments of our day and generation. For the London School of Hygiene sets a new standard in building and equipment, a standard worthy of the subject and of the Imperial city in which that subject is to be studied and investigated. The School is also the most important example—Oriental studies and history are other examples—of the new and proper method of organising higher instruction and research in selected subjects in London under the ægis of the University, a method which will inevitably be followed for many other academic and professional subjects if and when the University, through re-constitution, obtains the necessary powers and driving force.

The main frontage of the new building, of which an elevation is reproduced (Fig. 1), faces Keppel Street, looking southwards towards the impressive north façade of the British Museum, across the vacant site purchased by the Government for the University of London, and recently re-sold to the vendor, the Duke of Bedford. Return frontages, considerably longer than the main frontage, face Gower Street and Malet Street. The architects, Mr. P. Morley Horder and Mr. Vernon O. Rees, have produced a design combining simplicity and economy with dignity and the maximum of light and air. The building will be faced with stone drawn from Portland—the veritable womb of London. In addition to the teaching of hygiene in all its branches, provision has been made for tropical medicine, the London School of Tropical Medicine in Endsleigh Gardens having been amalgamated with the new institution. Altogether, the School will accommodate 250 students, including 100 students of tropical medicine. Routine instruction will be directed towards the various degrees and diplomas in public health, which form a necessary qualification for the public health service at home and abroad. The general shape of the building is a letter H closed at the south end by the Keppel Street frontage. The north court will be left open, and the south court will contain the lecture theatre. Ventilation, it is interesting to note, will be by 'natural' means, a provision for which those who have worked in buildings ventilated by 'scientific' methods will be grateful. Possibly, however, the School may itself devise new methods of ventilation, a worthy subject of hygienic research. One-sixth of the total accommodation will be reserved for research, the large lecture theatre and museum, as well as numerous class-rooms and laboratories, being regarded for the purpose of this computation as accommodation for teaching.

The division of the subject of hygiene adopted by the School has had reference to the regulations for the Diploma of Public Health, and is as follows: (1) applied physics, physiology, and the principles of hygiene; (2) chemistry and bio-chemistry; (3) immunology and bacteriology; (4) medical zoology, parasitology, and comparative pathology; (5) epidemiology and statistics; (6) principles and practice of preventive medicine, general sanitation, and administration. Dr. Andrew Balfour, in his interesting address to the Society of Medical Officers of Health on December 12, 1924, has explained the many ramifications of these subjects. Thus applied physiology includes nutrition, ventilation, illumination, physical exercise, not only in relation to adults. One of the most encouraging developments of recent years has been the increased attention to the special hygiene of infants and children. The hygienist approaches the realm of the educationist and psychologist in such questions as rest, sleep, and fatigue; the physiology of speech, reading, and writing; tests of intelligence. In his discussion of the position of chemistry, Dr. Balfour attaches little value, from the view-point of the training of the public health officers, to pure chemistry, but stresses the importance to bio-chemistry. "The future, in many directions, lies with the bio-chemist." In Division 3, the order "Immunology and Bacteriology" is deliberate. Division 4 relates mainly to tropical medicine. As regards Division 5, Epidemiology and Statistics, Dr. Balfour recognises the need for more stimulating teaching of epidemiology, and has a good

word to say for the methods adopted at Johns Hopkins University, under Prof. Frost. He admits that statistics is a "difficult and deadly subject for any one who is not blest with a gift for mathematics." Division 6, though placed last, is the largest and most important of all. Not less than thirteen special courses are grouped under the main heading. The subject is so wide and is developing so rapidly that Dr. Balfour's hint that "refresher" courses may be arranged for medical officers of health will not cause surprise.

It remains to add that the planning of the building corresponds to this comprehensive programme. Full details are given in the *British Medical Journal* (July 10, 1926). The lecture theatre (the flat roof of which will be laid out as a garden-court) and the museum (occupying 15,000 feet of floor space) are important features of the building. The library, a large and imposing room 35 feet by 120 feet, occupies the place of honour in the front of the building. There is a "Publications Department," in which provision will be made for informative and propaganda work. The Chemical Division in the north-east corner of the building will accommodate 70 students and the biochemical and nutritional laboratory 35 students; and there is also a number of staff and research rooms and a class-room with 70 seats. The third floor is mainly occupied by medical biology, and will absorb the greater part of the work of the old London School of Tropical Medicine in Endsleigh Gardens. It is hoped that the building will be completed in two years.

T. LL. H.

News and Views.

THE sixth annual report of the Forestry Commissioners (Sept. 30, 1925) is a document of considerable interest if only for the summary it contains of a forest policy recently enunciated by the Government. A century or two has elapsed since any Government in Great Britain can be said to have held definite ideas on the subject of what a forest policy for the country should aim at. The Government of the day has now publicly recognised that the development of such a policy is largely dependent upon State action continuously applied over a period of years, a point which has for long been beyond dispute in many European countries. It is further recognised that large areas of land in many parts of Great Britain are more suited to the production of timber than food, that private forestry should be encouraged by a system of grants, and that the systematic establishment of forest workers' holdings at the rate of 5 holdings per 1000 acres of afforestable land should be aimed at. It may be said at once that this definition of the Government's opinions and aims in this matter is admirable. If persevered in, the progress of forestry should be assured.

THE total area of land acquired by the Forestry Commissioners to Sept. 30, 1925, was 286,198 acres, of which 177,633 acres were classified at the time of acquisition as plantable. Of the plantable area 100,244 acres (56 per cent.) are in England and Wales and 77,409 acres in Scotland. The Crown Woods, *e.g.* Forest of Dean, New Forest, and so forth have now been placed under the Commissioners. When the Commission was appointed it was laid down that 150,000 acres should be afforested in the first ten years. In the Acland Report the rate of planting per year was prescribed; 50,000 acres to be planted by the sixth year. This acreage has been slightly exceeded. In some respects the laying down of rigid planting prescriptions by area is unfortunate, since the effort to maintain the planting figure may result in poor or bad work and takes no account of possible losses from drought and so forth, experiences well known to all foresters. It also results in waste. For example, in the table of cultural operations in the 1925 report, 22,615*l.* is shown as expended on planting and 9526*l.* on beating up, *i.e.* filling up plantations in which deaths have occurred. This represents nearly 40 per cent. of the planting expenditure. Forestry, like agriculture, has to face unfavourable climatic factors, but the excessive expenditure alluded to above appears difficult to justify.

THE debate, which is a usual feature of the *Forum*, in the issue for August deals with the question "Is Civilization Contagious?" and is opened by Prof. Elliot Smith with a statement of the case for 'diffusion.' The argument proceeds on the lines which he has already made familiar in putting the case for Egypt as the place of origin and centre of diffusion of culture. The reply is by Dr. B. Malinowski, who argues ingeniously that the opposition between 'diffusion' and 'independent invention' is misleading. He maintains that 'invention' is not a single event for which one single individual is responsible, but a process consisting of a series of infinitely small, infinitely many, steps for which many individuals are responsible. Every cultural achievement is due to a process of growth in which invention and diffusion have equal shares. The familiar example of the 'diffusion' of a match he regards as futile because the match does not become an element of the culture of the native, but is merely a mechanical importation. So far Dr. Malinowski's formal answer to the 'diffusionist'—in effect a compromise which would commend itself to the average anthropologist, if not to the out-and-out upholder of 'independent invention,' should there be any such, whom Prof. Elliot Smith holds up to scorn. But Dr. Malinowski's quarrel goes deeper, and it is this which constitutes the real value of his contribution to the discussion. Only in the field, he maintains, can the problem be solved as a live issue and by functional analysis. Then it appears that every aspect of culture corresponds to a specific need of human nature, to the local environment, and to the general character of given civilisation. The problem is resolved then by the writer's conclusion that diffusion never takes place; it is always a readaptation. Culture is neither

invented nor diffused, but is imposed by "the natural conditions which drive man upon the path of progress with inexorable determinism."

THE Rothamsted Experimental Station has renewed its offer to Chambers of Agriculture, the National Farmers' Union, Students' Societies and the like, to supply, during the coming winter, lectures on a variety of subjects. These lectures are offered by way of supplement to the provision already made by county education committees and agricultural colleges covering the general field of agricultural education. Coming, as they do, from workers engaged on agricultural research, the addresses should prove of extreme interest to their hearers. The agricultural sciences have now become so highly specialised, and the volume of research published daily is so great, that there is a great field of exposition open to those whose duty it is to keep in touch with new things in the branch of research with which they are specially concerned. On the other hand, the director of Rothamsted may be assumed to be fully aware of the value to the experts themselves of direct contact with the actual workers on the soil. While it is true that the pursuit of knowledge should be the sole object of the research worker, that pursuit is in danger of becoming too academic when confined to the laboratory alone. The list of subjects upon which lectures are offered is some indication of the scope of work with which the Rothamsted Station deals. Following the transference of the workers in phytopathology from Kew and Manchester, the station now deals with every aspect of plant life in health and disease, as it concerns the farmer. It may be added that a recent addition to the roll of lecturers is Mr. C. Heigham, whose thoughtful articles on the business aspects of farming were, until recently, a feature of the Saturday page in a London journal. The main headings of the syllabus which accompanies the Rothamsted circular are: soil micro-organisms; agricultural botany; agricultural chemistry; soil physics; insecticides and fungicides; entomology and mycology.

THE weather of August in the British Isles has just been dealt with by the Meteorological Office, in a tentative way, as a supplement to the *Daily Weather Report*, similar summaries being issued on the first day of each month. The promptness of the issue adds much to its value, dealing with facts while fresh to the memory. In many respects the weather of August this year is said to compare favourably with the average August weather. At Kew Observatory temperature and sunshine were both above the average, while rainfall was remarkably low—the lowest since 1899. During the last ten days of the month high barometric pressure spread over the southern districts, giving generally fine weather; at Kew there was no appreciable rain after August 21 until the early morning of September 1. About 12 hours' sunshine were enjoyed daily in south-east England on August 26-29, while day temperatures rose until August 30 when 83° and 84° were registered in London. Some abnormally high night temperatures were recorded during the latter part of the month. On the night of August 24-25 the thermometer remained well above 60° F. in many places, and did not fall below 65° F. in several parts of London. The mean temperature for the month at Kew was 64°·1, which is 2°·5 above the normal; winds were chiefly westerly and the barometer was high. Thunder only occurred on two days in London. The duration of bright sunshine at Kew was 207 hours, which is 20 hours more than the normal.

THE present status of long-range weather forecasting is dealt with by Prof. R. De C. Ward, of Harvard University, in an article written for the American Philosophical Society. The subject is being very actively considered not only in America but also in many of the European weather offices. Prof. Ward's purpose is to take stock of the subject rather than to offer any contribution to the discussion. He mentions that man's natural craving for advance knowledge of coming weather extends thousands of years back of any attempt at scientific weather forecasting. Allusion is made to the group of animal weather proverbs which have come into existence. Prof. Ward asserts that animals have no foresight which people credit them with, but these are simply characteristics of food supply and other conditions. Some credit is given to the very general forecasts based on sequences in the character of the seasons, but it is pointed out that just when a definite sequence seems to have started the chain is somehow likely to break and the sequence ends. With further and closer study something more definite may develop along this line. Allusion is made to the weather fluctuations associated with sunspot cycles, and it is stated that the results of these studies have not come up to expectations. A longer period generally recognised as having been fairly established is known as the Brückner 35-year cycle, but this may vary between 20 and 50 years. At present, and until such periodicities or variations are more fully understood, long-range forecasts definite and trustworthy cannot be based upon them. Prof. Ward, with high authority behind him, sums up the subject with the statement that the results reached are not yet generally applicable to definite seasonal forecasts, but there is, however, promise for the future.

AMONG the news items published in the *Bulletin for International Relations* (July) are the announcements of the adoption of the metric system in Greece on March 1 last, and of a decree of the Soviet Government for its introduction into Russia on January 1, 1927. A list of international scientific meetings to be held in 1927, 1928, and 1929 is also included. In 1927 there will be a congress of the International Institute for Cold, at Rome; a general assembly of the International Institute for Anthropology; a general assembly of the International Commission for the Investigation of the Air, at Prague; the sixth international Congress of Medicine, at Leyden; the seventh international Congress of Statistics, at Cairo; the fifth international Congress on Seed-Testing, at Rome, in May; the fifth international Congress of the Science

of Heredity, in Berlin (the first international congress to be held there since the War); the second Australasian Medical Congress, in Dunedin (N.Z.); in February; and a congress of the International Association of Medicinal Hydrology, in Italy. In 1928 there will be held an international Congress of Mathematics (the first to be held since the Toronto meeting in 1924), and in 1929 the seventh American Scientific Congress, at San-José, Costa Rica. The bulletin concludes with the communication, already announced in our columns (July 3, p. 21) that the International Research Council has decided unanimously to modify its statutes in order to make possible the adhesion of all States, without distinction; and to invite Germany, Austria, Bulgaria, and Hungary to join the Council.

AN important branch of engineering at the present time is the manufacture of water turbines and electric generators for operation in hydro-electric stations. In the July number of the *Journal of the English Electric Co.* an interesting account is given of a 25,000 horse-power water turbine which they have manufactured for the Sao Paulo Electric Co., Brazil, and which has now been running successfully for some considerable time in the Sorocaba Power Station. The station is on the river Sorocaba at a distance of sixty miles from Sao Paulo. The hydraulic power is converted by three 15,000 H.P. units, also made by the E. E. Co., and by this new turbine which acts in parallel with them. The new machine operates under a head of 670 feet of water and it has its rated output at 600 revolutions per minute. At full load the discharge of water is 400 cubic feet per second and the velocity of the water relatively to the vanes is 130 feet per second. As a very close speed regulation was desired the turbine guide vanes are closed in 1½ seconds when the load varies from full load to zero. The casing has the form of a logarithmic spiral. This gives a perfect intake vortex ensuring that the water all round the guide apparatus has the same entrance velocity. The formation of disturbing eddies is therefore avoided. The efficiency is about 90 per cent.

OUTDOOR switchgear, although in fairly common use in America and on the Continent in connexion with electric power transmission, is still rarely used in this country. The account given therefore by the English Electric Co., in the July number of its journal, of the switchgear the Company has erected in the open air for connecting the electric supply systems of the Preston and Blackburn Corporations by means of high-tension transformers and a 33,000 volt cable, is of interest and value. The two necessary sub-stations are almost identical. The switchgear is carried on a light steel structure supported by a concrete plinth on which stand four 2900 kilovolt ampere transformers, the ratio of transformation being from 6600 to 33,000 volts. On the low-pressure side the circuit is broken under oil, but on the high-tension side air-break switches are employed and are mounted with 'arcing horns.' The scraping action of the type of contact employed ensures the pushing away of any sleet or snow and thus renders the switches satisfactory for use under any weather conditions. The parts are so strong that the contacts can be separated even when they are frozen together. As this type of gear can be employed up to 110,000 volts, it is probable that it will soon become common.

THE National Research Council (U.S.A.) has published, in its reprint and circular series, an address on science and engineering by Prof. W. F. Durand, of Stanford University, California, in which the author deals in an interesting manner with a familiar theme—the nature and interdependence of fundamental and applied research. He points out that each element of material progress in civilisation is the final product of a vast number of interconnecting studies, all of which converge towards this product and have their source in fundamental facts or laws of Nature. He asserts that we can never get behind these basic facts, but he treads on somewhat debatable ground when he uses the term 'explanation' to connote description of phenomena in terms of basic concepts such as 'energy,' 'electrons,' and 'quanta.' As a good professor of engineering he believes that the results of fundamental research, and, indeed, that all knowledge, find their highest expression in terms of service to humanity; and he shows how certain types of industrial research are really fundamental, although all forms of research have their place as essential elements of progress. Engineering affords some excellent illustrations of the interdependence of academic and strictly utilitarian research, and the example of aeronautics, with its dependence on mathematics, physics, mechanics, thermodynamics, and chemistry, is a particularly happy one. In conclusion, Prof. Durand pleads eloquently for more intensive fundamental research in the United States, which he believes has been relatively neglected there.

MOST of the islands in the Azores are subject to earthquakes that occasionally attain destructive violence. One of the well-known centres, though not the most active, lies in the Horta district at the eastern end of the island of Fayal. In this zone a strong earthquake occurred on August 31. In Horta, hundreds of houses were completely ruined and there were few that remained undamaged. Heavy safes were thrown out of alcoves, steam boilers were displaced, and large fissures crossed the streets. Though the earthquake was felt in the neighbouring island of Pico and even at Ponta Delgada in the island of St. Michael, the disturbed area, as in most volcanic regions, seems to have been small, considering the strength of the shock at the epicentre.

THE following awards for the year 1926–27 have been made by the Salters' Institute of Industrial Chemistry and approved by the Court of the Company: Fellowships have been renewed to—Mr. H. S. Pink, University College, Nottingham, and University of Oxford (fellow, 1924–25, 1925–26), at the Massachusetts Institute of Technology; Mr. V. E. Yarsley, University of Birmingham (fellow, 1924–25, 1925–26), at the Polytechnic, Zurich; Dr. R. Campbell, Arm-

strong College, Newcastle-upon-Tyne, and University of Oxford (fellow, 1925–26), at the Department of Chemical Engineering, University College, London. Fellowships have also been awarded to—Mr. E. A. Bevan, East London College, University of London; Mr. R. M. Deanesly, University of Oxford; Mr. R. Edgeworth-Johnstone, College of Technology, University of Manchester; Mr. H. B. Spalding, University of Oxford. The Salters' Institute has also awarded fifty-one grants-in-aid to young men employed in chemical works to facilitate their further studies.

AN interesting addition has just been made to the exhibits in the electrical communication section of the Science Museum, South Kensington, by Messrs. Television, Ltd., who have lent to the Museum the transmitting portion of the original apparatus used by Mr. J. L. Baird in experiments which led him from the wireless transmission of outlines in 1925 to the achievement of true television nine months later, when, on January 27, 1926, the transmission of living human faces with light, shade, and detail was demonstrated before members of the Royal Institution. The subject of television was referred to in an article in our columns on July 3. The apparatus now placed on exhibition at South Kensington includes the original ventriloquist's head used in Mr. Baird's experiments, the revolving dial with lenses, the slotted disc which, revolving at high speed, interrupted the light reflected from the head, another revolving interrupter and the cell container with the aperture through which the flashes of light reach the sensitive cell.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant fishery officer in the Fisheries Department of the Ministry of Agriculture and Fisheries—The Secretary of the Ministry, 10 Whitehall Place, S.W.1 (September 20). Inspectors under the Agricultural Wages (Regulation) Act, 1924—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (September 24). A head of the Department of Commerce of the Witwatersrand Technical Institute—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (September 30). An assistant in the Essex Museum of Natural History, Romford Road, Stratford—The Principal, West Ham Municipal College, Romford Road, E.15 (September 30). An evening lecturer in botany at the West Ham Municipal College, Romford Road, E.15—The Principal (September 30). A pathologist to the Lancashire Asylums Board—The Clerk of the Lancashire Asylums Board, County Offices, Preston (October 1). Research chemists at the Chemical Research Laboratory, Teddington—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (October 7). An assistant master for engineering and workshop practice at the Kingston-upon-Thames Technical Institute—The Principal.

Our Astronomical Column.

SUSPECTED COMET.—Mr. Wilk, assistant at Cracow Observatory, who discovered a comet last year, has sent a telegram to the I.A.U. Bureau at Copenhagen announcing his detection of another cometary object of the sixth magnitude on September 1, $21^h\ 46^m{\cdot}0$ U.T., in R.A. $15^h\ 53^m\ 12^s$; N. Decl. 3° 55′ (position referred to equinox of 1855). The motion was stated to be direct (that is, in the direction of increasing R.A.), and according to the wording of the telegram it reached the extraordinary amount of one degree in four minutes, but it is doubtful whether this is the correct interpretation. If so, the comet was very near the earth, and no forecast of its position is possible until more data are to hand. The writer of this note swept for a few degrees round the given position on September 4 without detecting any bright comet.

FIREBALL ON AUGUST 13.—Mr W. F. Denning writes: "A large fireball was seen from various parts of England on August 13 at $9^h\ 13^m$ P.M. Among other places it was observed from Alford, Linc., Palling, Norfolk, Keynsham, near Bristol, and Derby. The meteor gave the impression of a brilliant rocket; for it illuminated the landscape and sparks followed the head along its somewhat lengthy course. As viewed from Derby it was described as being of an incandescent blue colour with a tail of similar tint and golden sparks. Another person says it emitted an intense bluish-white hue like lightning and that it vividly illuminated the country. I have compared the data and find that the radiant point is indicated at 303° – 13° near α Capricorni, and that the meteor traversed a path of about 84 miles, falling from 62 to 33 miles in height—velocity about 25 miles per second. The direction of flight was from south by east to north by west, and the meteor passed from over Huntingford to near Doncaster. The radiant point is a well-known one and has been often observed in July and August supplying slow and brilliant meteors."

THE PROBLEM OF 'ISLAND UNIVERSES.'—The true interpretation of spiral nebulæ, either as comparatively small bodies occurring merely as outlying members of our Galaxy, or, on the other hand, as very remote systems comparable both in size and nature with the Galactic system itself, still remains a matter of controversy. An important contribution to the problem is made by Dr. Hubble in the *Astrophysical Journal*, vol. 63, p. 236, in which a critical and detailed analysis is given of the naked eye spiral Messier 33, based on photographs taken with the great 100-inch reflector. The high resolving power of this instrument shows no difference between the images of so-called condensations and those of ordinary stars of the same magnitude. Ritchey's description of these objects as "nebulous stars" appears therefore to be no longer tenable. Numerous nebulæ, novæ, and variable stars have been discovered by Dr. Hubble in Messier 33, including 35 Cepheids. The distance as derived from the period-luminosity relation among the latter is about 263,000 parsecs. That this distance is of the right order of magnitude is confirmed by evidence from the novæ and from the luminosity function for the brighter stars. Dr. Hubble considers Messier 33 to be an isolated system of stars and nebulæ, far beyond the limits of the Galaxy; but as being more comparable in size and luminosity with the Magellanic clouds than with our own system.

Research Items.

REMISSION OF SINS AT THE SHRINE OF A MOSLEM SAINT.—A description of a fair at Pakpattan at the tombs of Bâbâ Farîd Shakarganj, which is quoted in the *Indian Antiquary* for August, contains several points of interest to the students of religious belief. The great attraction of this annual fair is the opening of the Gate of Heaven. On the death of the Bâbâ, who is credited in story with wonderful powers during his lifetime, it was published far and wide that whoever passed through his tomb between sunset and sunrise on the new moon in August would be forgiven the sins of the past year, and the fair was established for the benefit of the faithful attending at the tomb for this purpose. The fair is attended by worshippers drawn from districts so wide apart as the North-West Frontier and the United Provinces. On the final night when the gate is to be opened, all pilgrims collect outside the gates of the town, which are closed. On the signal by rocket that the sun is set, they are admitted to the town and all night long pass in single file through the tomb. At sunrise the door is shut. On one occasion the police used light switches to strike the people in order to hasten the movements of the crowd. The people, instead of avoiding the blows, courted them, and on inquiry as to the reason, it was stated that the switches represented the sword blades forming the legendary bridge between earth and heaven on which the feet of the faithful are cut, whereas the wicked fall between the gaps in the bridge into hell below. Those, therefore, who were hit by the police switches considered that they had had their feet cut by the swords of the bridge and were doubly sure of the forgiveness of their sins.

INTELLIGENCE AND FAMILY HISTORY.—Some interesting data bearing upon the question of how far superior intelligence is a family characteristic have been collected by Miss Grace Allen as the result of an investigation of 48 families to which belonged a number of children selected as the result of psychological tests by members of the Teachers' College, New York. The results have been published in *Bull.* 25 of the Eugenics Record Office of the Carnegie Institution of Washington. All the children were of exceptionally high character intellectually, and the study involved the more remote history of the family, present conditions, occupational and home ratings, physical and temperamental traits and birth conditions. Of these families 70 per cent. were Jews, and of these 20 per cent. of German extraction, and 10 per cent. more German on one side of the family. Only one child came of American stock on both sides, and in only three families were all four grandparents American born. As regards occupation, 70 per cent. of the fathers were professional men, and 25 per cent. did clerical or semi-intellectual work; 25 per cent. are college graduates, a frequency twelve times higher than in the population at large. Brothers and sisters and cousins tested for intelligence scored high. The fecundity was low, being about 0·8 of a reproducing child to each parent. First births occur twice as commonly as in the general population; but this is due to the fact that the intelligent groups have an exceptionally high population of first-born children only. The fathers are above the average age because this class marries late. Physically the families belong to a fine stock, being long lived and robustly built. The children show few physical defects. In a preface, Dr. Charles B. Davenport sums up the results of the investigation as showing that the highest intelligence comes out of a stock that is highly developed on both sides.

GLASS-MAKING IN ANCIENT EGYPT.—The technique of the manufacture of glass vases in ancient Egypt is obscure. Sir Flinders Petrie has suggested in connexion with the examples discovered by himself at Tel-el-Amarna, the use of a rod and a core of sand dipped into melted glass, while Mr. Harry Powell in the "Encyclopædia Britannica" suggested alternatively that they were blown. Mr. James H. Gardiner in *Glass* for July considers that the true method of production must differ from anything that has yet been suggested, basing his view on the examination of a number of examples of the XVIIIth Dynasty. The softening or plastic temperature is about 900° C., not a great deal below that of good English flint glass. Some, however, have been drawn from material which would have needed quite 1000° C. to form. In the case of a fish-shaped vase from Tel-el-Amarna, the body is a well-melted blue soda metal with fine seeds. The tail portion is solid and has been made and ornamented first and then squeezed on to the soft body. The indentation of the flat-nosed tongs used for holding can be distinctly felt. The coloured-glass pattern was made by threading coloured glass on to the surface. Notwithstanding the weighty negative evidence of an absence of any indications of blowing tools or fragments showing clear inside surfaces, the author is strongly of the opinion that the glass objects of the XVIIIth Dynasty show the beginnings of fabrication of glass vessels by blowing, which afterwards developed into the blown ware of the Greek and Roman period. It is suggested that the fact that in all cases there was a circular opening in the neck showing abrasion, as if a metal rod had been introduced and withdrawn, may have been due to the use of a metal funnel to introduce hot sand while the material was soft, and that the object was then buried in hot ashes to cool slowly.

THE GREAT RIFT VALLEY.—In a paper in the *Geographical Journal* for August, on the Nyasaland section of the great Rift Valley, Dr. F. Dixey advances the view that in early Cretaceous or possibly late Jurassic times, the initial uplift in the Nyasa region took the form of a gentle anticlinorium, or large anticline, and that the more or less meridional troughs so produced were occupied eventually by rivers. At a later date rift faulting began, and continued intermittently through a large part of Tertiary and Quaternary times. Intersecting faults also extended into the regions bordering the main rift on both sides. The volcanic history of the area seems to have been largely confined to late Tertiary or early Quaternary times. Dr. Dixey finds no evidence to support the hypothesis of a marine sedimentary phase of Oligocene age. Lastly, he gives reasons in favour of the rift-faulting of the region being due to long-continued tensional stresses rather than to compression. These are the absence of thrusts and folds and the development of much block faulting; the occurrence of subsidiary rifts parallel with the main rift; the existence of a reticulated system of rift valleys; low-step faults extending into the middle of the rift valley floor; and the successive tilting of the floor of the northern end of the rift in one direction.

TERTIARY FOSSILS FROM JAPAN.—No less than six papers on the tertiary mollusca of Japan, from the

pen of Prof. Matajiro Yokoyama, appear in the first volume of the Journal of the Faculty of Science of the Imperial University of Tokyo. Most of these fossils come from the central districts of the main island of Japan, but some are from the oil-fields in the north-western part of the "Main Island of Hokkaido" (formerly known as Yedo). Prof. Yokoyama's communications total 87 pages illustrated by 19 plates, which are very good, but not quite equal to the efforts of the Japanese artist at his best. The text, beyond brief statements as to the position and age of the respective beds in which they occur, is confined to systematic descriptions of the species, many of which are described as new.

BAXTER BASIN GAS-FIELD, WYOMING.—Mr. Julian D. Sears contributes an interesting account of the geology of the Baxter Basin Gas-field, Sweetwater County, Wyoming, in *Bulletin* 781-B of the United States Geological Survey. This field was first proved in 1922 by the completion of two wells of large yield; previously, drilling on the Rock Springs anticline, of which the Baxter Basin occupies structurally the highest part, had resulted in little or no success; even now there seems to be small prospect of oil being found in commercial quantity. Gas is found in commercial quantity, however, in each of the three domes developed along the crest of the main structure, and is produced from the Upper Cretaceous Frontier and Dakota sandstones. Each dome has its own gas-pool, there being no single continuous pool common to all three as they are separated by structural depressions and by faults that offset the reservoir beds. Twenty-three wells had been drilled in this field up to the time of survey; these ranged from 1000 to 3400 feet deep, finding the Frontier sands at depths from 1800 ft. to 2000 ft., and the Dakota sands at depths from 2500 ft. to 3400 ft., according to the positions of the wells concerned. Some remarkable yields are recorded: one well gave 2,000,000 cubic feet per day from the Frontier and 70,000,000 cubic feet from the Dakota; another well found water in the Frontier but yielded 21,000,000 cubic feet of gas per day from the Dakota; other yields from the Dakota (unquestionably the richest sand in the field) are from 17,000,000 cubic feet to 35,000,000 cubic feet daily. Water occurs high on the flanks of two of the productive domes, thus leaving very little room for an intervening oil layer between it and the gas; this is one of the reasons dispelling any hope of commercial oil production from this field.

CYCLONES OVER CEYLON.—Cyclonic movements in Ceylon are dealt with by Mr. A. J. Bamford, the superintendent of the Colombo Observatory, in the *Ceylon Journal of Science*, vol. 1, part 1, in continuation of the series that have appeared in the past in the bulletins of the Colombo Observatory. Any discussion of the movements of cyclones wherever dealt with is of general interest, as cyclones are so decidedly the centres of action with respect to the weather both over land and sea. In the discussion several storms are analysed, and much information can be gleaned as to the main seat of control in that part of the globe. Other special features are dealt with in detail, especially the heavy rains over Ceylon of September 29-30, 1924, falls up to 12 inches being reported which occasioned floods in many places. The weather over the island at the time was of the usual south-west monsoon type; the fall of temperature on September 29 is said to be the result and not the cause of the rains. Maps are given showing the rainfall over Ceylon.

CLIMATOLOGY OF FALMOUTH.—Weather observations at Falmouth for the year 1925 and the mean values for 55 years, 1871–1925, have just been issued by Mr. J. B. Phillips, the superintendent of Falmouth Observatory. The observations are of considerable value, as they show great equability of the climate throughout the year. The mid-winter month January had the day maximum temperature between 50° F. and 54° F. on 24 days, and there was only one day with the temperature below 45°; the minimum or night temperature was only below 40° on six days and on three days was above 50°. The mean temperature for January was 3°·4 above the average. In November and December, when periods of exceptionally cold weather were experienced over Great Britain, the relation of Falmouth to other parts of the country is interesting. The mean temperature for the year was 51°·5, which is 0°·7 above the normal; the warmest months with relation to the average for 55 years were January and October, both of which exceeded the average by 3°·4. The total hours of bright sunshine in the year were 1819, which was 69 hours above the mean, and it was the highest for the year since 1911, when the sun shone for 2056 hours. During the first six months of 1925, Falmouth had 43 per cent. of the possible duration of sunshine, while that for the British Isles was 35 per cent. For June, Falmouth had 77 per cent. of the possible duration of sunshine, while for the British Isles it was 50 per cent. The daily average sunshine at Falmouth for the several seasons was: spring 5·41 hours a day, summer 7·88 hours a day, autumn 4·33 hours a day, winter 2·36 hours a day. The total rainfall for the year was 49·77 in., which is 4·01 in. more than the mean. The outstanding feature of the year was the rainless period from May 29 to July 3, absolutely no rain falling in June, while the mean for 55 years is 2·24 in.

THE CRYSTAL STRUCTURE OF MAGNESIUM PLUMBIDE.—With the publication of J. B. Friauf's results on the crystal structure of magnesium plumbide (Mg_2Pb), in the *Journal of the American Chemical Society* for July 1926, the crystal structures of the three intermetallic compounds which magnesium is known to form with silicon, tin, and lead, are now completely determined. The plumbide, prepared by melting the calculated amounts of magnesium and lead under a protective layer of sodium and potassium chlorides, was ground to powder under kerosene, and a sample, covered with a little paraffin, rotated during exposure to radiation from a molybdenum target. The powder diffraction pattern was photographed, and the unit cell found to contain four molecules. The position of the atoms corresponded with the calcium fluoride arrangement.

SPIRIT THERMOMETERS.—The August issue of the *Journal of Scientific Instruments* contains an article by Mr. W. F. Higgins, of the National Physical Laboratory, of considerable importance to the makers and users of spirit thermometers. It has been noticed that the readings of certain spirit thermometers when placed in melting ice have decreased with age at rates of the order of 1° F. per month. Experiment has shown that the decrease is not due to loss of spirit, through minute cracks in the glass or to change of volume of the glass, but to the presence of small quantities of acetone in the methyl or ethyl alcohol used in the instrument. Ten per cent. of this impurity is sufficient to cause a lowering of the ice point at the rate of 1° F. every ten days for the first few months after the thermometer is made. The effect appears to be due to the polymerisation of the acetone under the influence of light.

Excavations in Kent's Cavern, Torquay.

AT the Southampton meeting of the British Association last year, a Committee was appointed to co-operate with the Torquay Natural History Society in investigating the important palæolithic site at Kent's Cavern, made famous by the researches of McEnery, Buckland, and Pengelly. For some time previously the future of the cave, which is in private ownership, and the possibility of dispersal to unknown destination of relics of antiquity which might be of the greatest moment for the early history of man in Britain, had been a source of anxiety to the local scientific society and to archæologists generally. It was hoped that the British Association Committee would be able to some extent to mitigate the dangers of the situation; but at the time of its appointment there seemed little hope of immediate excavation, and at the most it was hoped that it would hold a watching brief for archæology and ensure that any specimens of interest or importance to science which might come to light should, at least, be recorded and if possible made available for study. Early last winter, however, leave was obtained from the proprietor for a preliminary examination of that part of the cave known as the 'Vestibule.' Funds were raised from the British Association, the Royal Society, the Society of Antiquaries, and a fund for the employment of ex-service men; but the greater part of the work has been carried out voluntarily by members of the Torquay Natural History Society. A summary of the results of these excavations is contained in a report of the Committee which was presented at the Oxford meeting of the Association.

'The Vestibule,' which was selected for excavation on the advice of Prof. W. J. Sollas, is a chamber some 40 ft. by 32 ft., into which the northern entrance to the cavern leads. A trench was dug along the entire length of the northern wall slightly overlapping into the 'Sloping Chamber' and passing at its eastern end under the Magdalenian hearth discovered by Pengelly in 1866, which is known as the 'Black Band.' A beginning of a trench along the east wall in the direction of the entrance was also made. The depth of the trench varies from 2 ft. 6 in. to 13 ft. according to the nature of the deposit. The area which produced the greater part of the finds was near the east wall. Heavy blocks of limestone were present throughout. At each end of the trench crystalline stalagmite has appeared at the bottom of the excavation, but it is too early to say if this represents portions of a stalagmite floor.

The cave earth is quite unstratified and the fauna identical with that found by Pengelly at the higher levels. No hearths or workshops were found, but 135 flints scattered here and there have been recovered. Nearly all are patinated a dull white. Omitting waste fragments and neuclei, they fall into two classes: end scrapers and 'blades,' the latter being about 80 per cent. of the total. The end scrapers are of the usual type with primary flaking along the length of the implement, terminating at the broader end in steep, fanwise retouches producing a convex scraping edge. The reverse is a flake surface. The implement is in the Aurignacian tradition. The 'blades' have primary flaking along the length of the implement with two facets meeting in a carinated median line, or three facets, when the central facet makes a flat ridge. This would appear to be an industry of simple unretouched blades, and corresponds to the implements collected by Pengelly from the higher levels. The absence of bone, horn, and ivory implements suggests that it is not true Magdalenian; the absence of Chatelperron and Gravette points that it is not true Aurignacian; and of burins that it is not either Aurignacian or Magdalenian. Certain similarities to Solutréan are probably intrusive. It is, however, certain that we have here a culture of Upper Palæolithic type.

The abundance of remains of the horse would indicate a steppe climate suggestive of the Aurignacian and Solutréan periods of southern France, but reaching England at a later date. The study of the fauna suggests that the cave earth was in process of formation when the upper part of the base level and the lower part of the middle levels were laid down in Mother Grundy's Parlour at Creswell, of which the upper middle level roughly corresponds to the Black Band of Kent's Cavern. The deposits recently examined in the Aveline's Hole in the Mendips seem to correspond to the granular stalagmite excavated by Pengelly.

In a skull found in a crevice outside 'the Vestibule' Sir Arthur Keith finds a close correspondence in the palate and teeth to those of the human jaw found in the granular stalagmite. It is brachycephalic and compares closely with two brachycephalic skulls found at Aveline's Hole, also associated with an industry of simple unretouched blades.

Irish Limnology.[1]

ALTHOUGH the study of lake life has received considerable systematic attention by other countries, especially on the Continent and in the United States, there had been no definite institution set up for that purpose in Great Britain or Ireland until the year 1920. It remained for the War to direct attention to our lack of knowledge of British lakes and their possible economic value; and, as a direct outcome of consultations at that time, a limnological station was established in August 1920 on the river Shannon, one mile from the northern end of Lough Derg, Ireland being considered the most suitable country in which to tackle the problem on account of its valuable inland fisheries and large area of fresh water.

The first report from the limnological laboratory by Mr. R. Southern and Mr. A. C. Gardiner, now before us, deals chiefly with the Crustacea in the plankton of Lough Derg and the river Shannon. The research, which included two full years, 1921 and 1922, was carried out with a thoroughness and attention to detail worthy of the greatest praise. Five to seven stations were worked with regularity, the positions being chosen so that information could be obtained on the plankton of the Shannon River itself and of the northern end of Lough Derg in regions outside and within the effect of the river's current and in special localities in which the effects of wind action might be shown. The technique of the plankton collecting was carefully worked out, and it is satisfactory to note that the results are based on collections made by horizontal hauls, although vertical hauls were generally taken at the same time. A great deal of attention was devoted to making these horizontal hauls as uniform as possible, and an ingenious method of

[1] "Fisheries, Ireland, Sci. Invest.," 1926, 1. Reports from the Limnological Laboratory. I. The Seasonal Distribution of the Crustacea of the Plankton in Lough Derg and the River Shannon. By R. Southern and A. C. Gardiner. Pp. 1-170. Plates I.-XV. Text figs. 1-4.

drifting from an anchored boat until 100 yards of greased rope had run off a reel, and then rowing back through this 100 yards in a given time, was adopted, and ensured, so closely as is practicable, that fairly equal volumes of water were filtered on each occasion. Concurrently with the plankton collecting, observations were made of the following chemical and physical factors—temperature (air and water), wind, rainfall, water level, transparency of the water, hydrogen ion concentration, dissolved oxygen and complete chemical analysis of the water.

Examination of the physical and chemical conditions has shown that Lough Derg differs from many lakes of which the features have been described on the Continent and in America, in that its waters are practically homogeneous from surface to bottom throughout the year, any evidence of a thermocline, and hence marked changes between surface and bottom oxygen content, being absent. This, in Southern and Gardiner's opinion, can be accounted for by the general shallowness of the lake (rarely more than 20 feet in the northern half, although the southern end is deeper with soundings as great as 119 feet), its narrowness, and hence continual change of the body of water flowing through it and the general mixing action of winds over the shallow water. In consequence, all the water of the lake is capable of supporting an abundance of living plankton organisms and of fish life. The ratio $\frac{Na + K}{Ca + Mg}$ is low: the phytoplankton is characterised by the relative scarcity of the Desmidiaceæ and dominance of the Diatomaceæ. This supports Pearsall's theory that if the above ratio is low the conditions favour the growth of diatoms, and, if high, of Desmids. It was also notable that large numbers of different species occurred together, at the same time, in great abundance. A further report on the phytoplankton is to be published.

The distribution of the crustacean plankton is considered from all aspects—seasonal and diurnal, both horizontally and vertically. In the horizontal distribution great stress is laid on the wind as a factor in causing irregularity, and the detailed discussion of the effects of winds is being kept for a subsequent report. Of the crustacea, *Daphnia longispina* was the dominant form, though *Bosmina coregoni*, *Leptodora Kindtii* or *Diaptomus gracilis* were most prevalent at times.

The importance of plankton crustacea as food for fish is discussed. Of the fish present in the lake, the Pollan, *Coregonus elegans*, is a plankton feeder throughout its whole life; these crustacea were also found to be an important constituent of the diet of the fry of pike, tench, rudd, bream, and perch. A correlation between the growth-rate of perch fry and the abundance of crustacea is given. It is interesting to see that to a certain extent big trout were also found to be feeding on plankton. The fact that these sporting fish will feed voraciously on small entomostraca is perhaps not generally known. In this respect it is interesting to direct attention to an experiment carried out at the Jersey waterworks showing the remarkable growth of young trout which fed on the abundant crustacean plankton present in the filter beds.[2]

It is sad to see that, after such a good beginning, the limnological station on the river Shannon is now closed down. It is necessary that such well-planned work should be carried out through the course of many years before the true significance of many of the seasonal changes in the plankton community can be fully understood and the foundations laid for a close study of the actual fish-producing power of these lakes.

Messrs. Southern and Gardiner have made an important addition to the many valuable works that have been published from time to time by the fisheries of Ireland. F. S. R.

[2] "The Biology of Jersey Waterworks," by W. Rushton, P. A. Aubin, and A. J. Jenkins. Published by the Institution of Water Engineers, 1925.

Studies on the Origin of Cultivated Plants.

THE history of cultivated plants is a subject which has attracted many botanists, and numerous theories of their origin from one or more wild prototypes have been published. Until recently the conclusions of Alphonse de Candolle have been accepted with a minimum of critical revision. The great increase in genetical research and the marked desire of many geneticists to link their studies with other aspects of biology is, however, leading to renewed interest in the taxonomic and geographical history of our common cultivated plants. Much new material has been accumulated and a few geneticists are even devoting time to collecting in person cultivated, feral, and wild examples of the genera and species they are studying in experimental ground and laboratory.

Prof. N. Vavilov, Director of the Institute of Applied Botany and New Cultures, Leningrad, is well known in Great Britain by the numerous important works on genetics and allied subjects which he has published. In a paper which has recently been received [1] he deals in a decidedly original manner with the origin of the common cereals and a few other widely cultivated plants. The conclusions reached are very largely based on the researches carried out by Prof. Vavilov and his assistants in Central Asia and the Nearer East in the years since the War. In addition, many thousands of seed samples have been obtained from all parts of the world and grown at one or other of the experimental stations under the control of the Institute. While it is certain that many details have still to be discovered for all the groups studied, there is no doubt that important problems have already been solved, and that further applications of the new methods will aid in the elucidation of many obscurities in the past history of all species and races which have been so long in cultivation that not even archæological researches can alone prove their origin.

The law of homologous series, expounded by Prof. Vavilov in an able paper in the *Journal of Genetics*, 12, 47, 1922, is applied here with the purpose of finding the geographical centre, or centres, of maximum varietal diversity within what is accepted as a "Linnean species." The data are set forth in tables and illustrated by exceptionally clear maps in the Russian text, to which is attached an almost full English translation. The results are comparable with the periodic classification of the chemical elements in that not only are the known variations classified, but also the existence of undiscovered varieties is postulated. In addition to the usual 'characters' of the taxonomist and morphologist, physiological characters, such as immunity to diseases and seasons of vegetative activity and of flowering, and cytological and genetical data are freely used. It was found that even for cultivated plants the variations are not haphazard in their geographical distribution, but that they occur about well-marked centres. The immense diversity of spring and winter forms of soft and club

[1] From *Bulletin of Applied Botany and Plant Breeding*, 16, 2, 1926, Leningrad.

wheats is concentrated in the mountainous districts of south-west Asia, while the polymorphism of the durum wheats is most marked in North Africa. Two centres of origin for the barleys are indicated in Abyssinia and south-east Asia. Cultivated oats are undoubtedly of polyphyletic origin, and five geographical and genetical groups are established. South-west Asia is recognised as the chief centre of diversity of rye. There is no reason to regard *Secale montanum* and *S. fragile* as progenitors of cultivated rye. Both oats and rye probably entered cultivation simultaneously and independently in different localities, primarily as weeds in crops of wheat and barley. Flax is referred to two principal groups: a large-seeded, large-flowered group connected with the Mediterranean, and a small-seeded, small-flowered one peculiar to south-west Asia. A third group may be centred in Abyssinia. It is shown that the mountainous districts of Asia and the Mediterranean region, being the centres of varietal diversity of nearly all the most important agricultural crops, were probably also the home of primeval agriculture.

The final paragraphs of Prof. Vavilov's stimulating paper form a fitting conclusion to this notice of his work: "Evolution proceeded in time and space, and only by coming near the geographical centres of the origin of forms, by establishing the links connecting species, shall we be able to master the synthesis of Linnean species (considering them as systems of forms). Only systematics and the knowledge of the geography of plants enable the geneticist to select consciously the initial forms for his crosses and to solve problems of experimental phylogenetics. The problem of the origin of species is thus considered as the problem of the origin not of separate varieties, which in Darwin's opinion differentiated into individual species, but of complex systems, such as are true Linnean species.

"As it follows from the above, the solution of the problem of the origin of species lies in a synthesis of thorough investigations of separate groups of plants by the differential systematical methods, by that of botanical geography (in the sense of establishing the centres of the origin of forms), and the methods of genetics and cytology. Only in using systematics, differential geography, genetics and cytology, can we find a way to the strongholds hiding the origin of species."

W. B. TURRILL.

University and Educational Intelligence.

LEEDS.—With the co-operation of the International Education Board of New York, an exchange of posts for the academic year 1926–27 has been effected between Prof. Olis F. Curtis, professor of plant physiology, Cornell University, Ithaca, New York, and Dr. W. H. Pearsall, reader in botany, the University, Leeds. Dr. W. H. Pearsall sailed for America in time for the International Congress of Plant Sciences, which was being held in Ithaca during August, and to which he communicated an account of his investigations of the aquatic flora of the Lake District, England. Prof. Curtis, who arrives in Leeds this month, has published interesting papers in many fields of plant physiology, but is best known for his work upon the channels in which food substances travel through the plant.

DR. NOEL J. G. SMITH, of the Department of Botany, University of Aberdeen, has been appointed professor of botany in the Rhodes University College (University of South Africa), Grahamstown. Dr. Smith was educated at the University of Edinburgh and at Cambridge.

BY the will of the late Sir John Williams, Bart., President of the University College of Wales and of the National Library of Wales, who died on May 24, leaving estate of the gross value of 123,742*l.*, the residue of the property, which will amount to nearly 100,000*l.*, is bequeathed to the two institutions of which he was president.

"MOTIVATION OF ARITHMETIC" is the title of a sixty-page report by Mr. G. M. Wilson, professor of education, University of Boston, published as Bulletin 1925, No. 43 of the United States Bureau of Education. It is based on some five thousand replies received from teachers in all parts of the country, and leads to the general conclusion that arithmetic, in spite of isolated attempts at motivation, is still largely a formal subject. Prof. Wilson's point of view is indicated by the question he urges teachers to think over: Should life be brought in to illustrate arithmetic, or should arithmetic be subordinated and become a means for the interpretation of life? There is, as he says, much work ahead for those who would realise the ideal of school work on a real life basis. Meanwhile his pamphlet with its examples of "actual life situations," of life situations used as a basis for school exercises, games, game devices, and other devices, representative of methods used by the most progressive and intelligent teachers in the public schools of the United States, will help substantially towards approximating school practices to his ideal. The bulletin is a good example of the levelling-up work undertaken by the United States Bureau of Education through making widely known among teachers the practices of the best.

THE report on the work of the Department of Petroleum Technology of the Sir John Cass Technical Institute for the session 1925–1926 has been issued. This department was established about five years ago to provide technical instruction for those engaged in or desirous of entering the petroleum industry. The courses include lectures on petroleum technology, on the properties, applications, and examination of petroleum, on the chemical and physical properties of petroleum, and on the applications of engineering, also mechanical drawing; provision is made for those possessing no previous knowledge of experimental science to take the preliminary course of elementary chemistry, elementary physics, and practical mathematics. The record for the session shows satisfactory progress, in the case of the petroleum lectures, Part 1, there being no less than 90 class entries engaged in all for 1343 'student hours.' The report comments on the educational value of kinematograph films of the petroleum industry, two of which were exhibited during the session; such films enable students "to see in true perspective the ramifications of the industry and the difficulties associated therewith." Those responsible for directing the work of this department deserve much credit for the valuable work accomplished in a comparatively short space of time. A strong feature of the organisation is the existence of the consultative committee composed of recognised experts in the industry; this committee is not only of use in advising on work schedules, but, acting in liaison with the principal oil companies in London, it also ensures what is so vital in all academic treatment of petroleum technology—constant contact with the industry itself.

Contemporary Birthdays

September 12, 1851. Sir Arthur Schuster, F.R.S.

September 14, 1849. Prof. Ivan Petrovitch Pavlov, For. Mem. R.S.

September 16, 1859. Mr. Basil Mott, C.B., M.Inst.C.E.

September 17, 1859. Dr. Frank Dawson Adams, F.R.S.

September 18, 1854. Sir Richard Tetley Glazebrook, K.C.B., F.R.S.

Sir ARTHUR SCHUSTER was born at Frankfort-on-Main, and he was educated at the University of Heidelberg, and at Owens College, Manchester. Professor of physics in the University of Manchester, 1888–1907, he was a secretary of the Royal Society from 1912 until 1919, and president of the British Association at the Manchester meeting of 1915. As chairman of the executive committee of the National Physical Laboratory for the six years' period, 1919–1925, Sir Arthur rendered important services, not only to the institution, but also to science in general. It is worthy of recall that in his article "Spectroscopy," in the "Encyclopædia Britannica" (11th edit., 1911), Sir Arthur remarks in a footnote that he believes he was the first to introduce the word 'spectroscopy' at a Royal Institution lecture. This discourse was delivered January 28, 1881, under the title, "The Teachings of Modern Spectroscopy."

Prof. I. P. PAVLOV, the distinguished Russian physiologist, is a foreign member of the Royal Society, and he was Nobel laureate in physiology and medicine for 1904. Prof. Pavlov's earlier researches related to the physiology of the circulation, and especially the nerve supply of the blood-vessels. Soon, however, he was concerned in chief with the physiology of digestion, establishing new methods of procedure in the examination of functions, and deducing conclusions which have proved of fundamental importance in the whole study and range of the subject. In 1915 Prof. Pavlov was awarded the Copley medal of the Royal Society.

Mr. BASIL MOTT received his early technical training at the Royal School of Mines. Mr. Mott was president of the Institution of Civil Engineers in 1924.

Dr. F. D. ADAMS is emeritus dean of the Faculty of Applied Science, and Logan professor of geology in McGill University, Montreal. Born in that city, he was educated at the High School there, graduating at McGill. He is Hon. LL.D., Toronto. Dr. Adams has conducted many researches in economic and experimental geology. An account of one of these (in collaboration with Dr. J. T. Nicolson), entitled "An Experimental Investigation into the Flow of Marble," was published in the *Philosophical Transactions* for 1901.

Sir RICHARD GLAZEBROOK, foreign secretary of the Royal Society, was educated at Liverpool College, and at Trinity College, Cambridge, graduating 5th wrangler. Sometime assistant director of the Cavendish Laboratory, he was afterwards principal of University College, Liverpool, from 1898 until 1899, retiring to become director of the newly established National Physical Laboratory, a post which he filled with acumen and distinction for fifteen years. He is now chairman of the executive committee of the Laboratory. Sir Richard was awarded the Hughes medal of the Royal Society in 1909. Author of a number of valuable text-books, the editorship of the "Dictionary of Applied Physics" is his latest service to scientific publications of permanent value.

Societies and Academies.

PARIS.

Academy of Sciences, July 26.—Gabriel **Bertrand** and M. **Macheboeuf**: Nickel, cobalt and diabetes. Injections of saline solutions containing small quantities of these two metals in some cases of diabetes proved to be without effect; in others, there was a marked improvement. Administered by the mouth, in one case of diabetes, the amount of insulin injected daily could be reduced by 25 per cent.—**Rateau, Leroux** and **Bourgeat**: The experimental determination of the coefficient of yield of tuyères working with a free flow.—Kyrille **Popoff**: The convergence of series in ballistics.—E. M. **Antoniadi**: Changes recently observed on the planet Jupiter with the 83 cm. telescope of Meudon Observatory. A detailed description of recent changes in the surface of the planet, with two reproductions of photographs.—Léon **Brillouin**: A general type of problems, allowing the separation of the variables in the undulatory mechanics of Schrödinger.—Louis de **Broglie**: Remarks on the new undulatory mechanics.—Lucien **Mallet**: The luminescence of water and organic substances submitted to γ-radiation. Under the influence of the γ-rays, water and certain transparent organic liquids exhibit a marked luminescence. The light from water contains ultra-violet rays of wave-length less than 3000 Å.U.—F. **Wolfers**: A probable action of matter on the quanta of radiation.—Pierre **Auger** and Francis **Perrin**: The distribution in space of the directions of emission of the photo-electrons.—Rodolphe **Berthon**: The projection and reproduction of reticulated photographs.—Pierre **Thomas** and Mlle. Mari **Sibi**: Contribution to the study of the structure of jellies. Organogels obtained with the benzoylacetal of sorbite.—P. **Dumanois** and P. **Laffitte**: The influence of the pressure on the formation of the explosive wave. From experiments $(2H_2+O_2)$ with initial pressures from 1 to 6·5 atmospheres, the distance travelled by the flame before the explosive wave is set up diminishes as the pressure increases, at first rapidly and then more slowly.—Michel O **Samsoen**: The dilatometric and thermal study of glasses composed of silica and soda.—Marcel **Laporte** and Mario A. da **Silva**: The mobility of the negative ions and ionisation currents in pure argon. From the results of earlier work, it was concluded that in perfectly pure argon the saturation current would be obtained with a much lower potential difference than in air: this prediction is now confirmed experimentally. The curves given show that saturation is obtained in highly purified argon at 50 volts, whilst in air, saturation is not reached at 1760 volts. The effect of impurities on the ionisation curve of argon is shown.—Georges **Denigès**: The action of hydrobromic acid and of the alkaline bromides in acetic acid solution on cupric bromide. A new cupric reaction. The reaction is based on the colour produced by the addition of a cupric salt to pure acetic acid containing some potassium bromide.—A. **Travers** and **Malaprade**: The constitution of solutions of molybdic acid. Solutions of molybdic acid contain a condensed acid, $4MoO_3 . H_2O$, which, by analogy with metatungstic acid, may be called metamolybdic acid.—R. **Cornubert** and Ch. **Borrel**: The action of benzaldehyde on cyclanones containing the groups $—CH(CH_3).CO.CHR\cdots$ or $—CHR.CO.CH_2—$.—G. **Bruhat** and V. **Thomas**: The dimagnesium compounds containing the benzene nucleus. An account of the general reactions of compounds of the type $C_6H_4(MgI)_2$.—G. **Vavon** and **Jakeš**: The catalytic hydrogenation of conjugated double bonds. So far

as concerns the addition of hydrogen by the catalytic method, the presence of a system of conjugated double bonds does not entail any special ease of hydrogenation, and does not permit partial hydrogenation in the 1 : 4 position. From this point of view, there are marked differences between the catalytic and nascent hydrogen methods of reduction. —Marcel **Sommelet** : A mode of preparation of tertiary amino derivatives of tertiary alcohols.— V. **Ipatief** and B. **Dolgof** : The hydrogenation of triphenylcarbinol and of phenylfluorenecarbinol under pressure. The end product of this reaction is tricyclohexylmethane $(C_6H_{11})_3CH$, the analysis and physical properties of which are given. The product previously described under this name by Godchot is shown to have been impure.—L. **Léger** and F. **Blanchet** : The grit formations of the isles of Port-Cros and of the Levant.—E. **Rothé**, J. **Lacoste** and Mme. A. **Hée** : Earthquakes in France in 1925. There were twelve earthquakes in France in 1925, only half the number in the preceding year. Details of the distribution and intensity are given.—Lucien **Mayet** : The fossil men of the Denise : the masculine frontal bone (the Frontal Aymard of the Crozatier Museum) at the Puy, Haute-Loire. A detailed study of this bone shows it to be clearly of the type *Homo sapiens*, and presents archaic characters in the sub-orbital region which are only found to-day in the most primitive existing race, the Australian aborigines.— **Michel-Durand** : The physiological rôle of the tannins.—Antonin **Němec** : A chemical method for determining the phosphoric acid requirements of agricultural soils.—Mme. Anna **Drzewina** and Georges **Bohn** : The influence of carbon dioxide on the sperm of the sea-urchin, as a function of the mass.—Max **Aron** : Experimental facts relating to the harmony of growth in the larvæ of frogs.—Charles **Dhéré** and Elphège **Bois** : The comparative study of the fluorescence of some natural and artificial porphyrins.— **Béguet** : The mechanism of agglutination (as regards *Br. melitensis*).—R. **Boyé** : The comparative action of quinine stovarsolate and chlorhydrate in quartian marsh fever.—F. **Rathery** and Mlle. L. **Levina** : The influence of salts of nickel and cobalt on some diabetic patients. Detailed accounts of the treatment and results with eleven patients.

August 2.—Jean **Perrin** and Mlle. **Choucroun** : The parallelism between the fluorescent power and velocity of reaction. Recent views on the production of fluorescence can be brought into line with the theory of Arrhenius (1889) on the existence of activated molecules. The velocity of destruction of a fluorescent body by a suitable reagent should be proportional to the average duration in the activated state, and consequently the probability of destruction of a given molecule should be greater at small concentrations than at high concentrations. Experimenting with methylene blue, it was found that (provided the pH remained constant) there was proportionality between the brightness of the fluorescence and the reaction velocity : changing from concentration 1/200 to concentration 1/1500, the brightness was multiplied by 10·5 and the reaction velocity by 11.— J. F. **Ritt** : Simplification of the method of Liouville in the theory of elementary functions.—**Akimoff** : The application of Fourier-Bessel transcendentals with several variables to the development in trigonometrical series of conditionally periodic functions.— **Mandelbrojt** : The trend of functions represented by Dirichlet's series and the growth of analytical functions round a singular point.—Georges **Alexitch** : The values of an analytical function taken on the circumference of the circle with radius unity.—N. **Podtiaguine** : The order of the growth of functions.—S. A. **Gheorghiu** : The theory of correlation.—Mlle. St. **Maracineanu** : Special actions of the sun on the radioactivity of polonium and lead. The experiments described appear to indicate that the solar radiation can cause the reintegration of radium E starting from radium F (Po), a reversibility in the radioactive series.—Pierre **Vernotte** : A regulator of E.M.F. and of current.—A. **Guillet** : The rectifying contact. A discussion of the theories of the action of the detector in wireless telephony.—A. **Dauvillier** : The telephote, an apparatus for television with the aid of vacuum tubes. Preliminary experimental results. —Eugene **Laborde**, Jean **Bressolles** and Léon **Jaloustre** : The influence of some radioactive elements on the catalytic activity of certain proteo-bismuth precipitates. The catalytic activity of the radioactive proteo-bismuth compounds (towards solutions of hydrogen peroxide) depends on the nature of the radioactive element present and its concentration in the medium in which the precipitate was formed. Barium alone is not without influence. Some possible therapeutic applications are indicated.—Mlle. **Choucroun** : The radio-chemistry of fluorescent bodies. Certain fluorescent organic substances (such as methylene blue) dissolved in a reducing medium are destroyed when exposed to light. Some irregularities in the velocity of this reaction have been traced to the influence of the pH of the medium. On adding a buffer solution (sodium acetate) the irregularities are greatly reduced.—A. **Travers** and **Houot** : The thermal study of electrolytic lead. The allotropy of lead. The dilatometric study of highly purified lead gives results consistent with the assumption that there are three allotropic forms of lead.—Robert F. **Le Guyon** : A new general analytical method : volumetric analysis, using a centrifuge. In volumetric precipitation methods of analysis, for which no suitable colour indicator is available, the use of a centrifuge is suggested. —J. **Orcel** : An attempt at the classification of the chlorites. The classification is based directly on the analytical results, using four characteristic ratios : s, f, a, and c, where $s = SiO_2/R_2O_3$, $f = FeO/MgO$, $a = Fe_2O_3/Al_2O_3$, and $c = Cr_2O_3/Al_2O_3$.—E. **Passemard** : The alluvial terraces of the Euphrates and the prehistoric implements they contain.—Henry **Hubert** : First observations relating to (electrical) atmospheric parasites in Western Africa.—Mlle. Laura **Kaufman** : The effect of the heterogeneous embryonic juice on the rapidity of emigration of the cells and the first stages of growth of cultures of tissues.—Paul **Camboué** : The prolongation of life in decapitated butterflies.— Baptiste **Roussy** : Unexpected and striking psychic facts manifested by a series of spiders of the genus *Epeire diademe* for keeping their webs in a vertical plane. These spiders attach to a line and lift to a distance from the soil heavy bodies (leaden wire, stones, snails), this serving the purpose of maintaining the web vertical. In one case the weight of the lead was 0·27 grams and the weight of the spider lifting it was 0·05 grams.—F. **Henrijean** and W. **Kopaczewski** : Researches on the composition of the squill and its tonicardiac principle.

August 9.—Jacques **Chapelon** : The minima of quadratic forms.—René **Lagrange** : Legendre functions of the first species and certain associated functions.—S. Piña **de Rubies** : The arc spectrum of europium. Measurements made at the normal pressure, between $\lambda 3500$ and $\lambda 3100$.—P. **Budnikoff** : The activation of the inert varieties of calcium sulphate. Natural anhydrite and the calcium sulphate obtained by dead burning gypsum do not set in contact with water, but can acquire this

the other hand, originative invention, although active in the wireless art, was during the War years largely diverted from the arts of peace. On the whole, therefore, there was a dearth of permanently useful originative inventions during that period, and it is to this circumstance that the present phase of unemployment may be largely attributed. If any doubt is felt on the subject, a comparison with the case of the wireless industry will afford conviction.

This is precisely the situation which can be ameliorated by wise improvements in the patent system, the purpose of which is to foster originative as distinct from intensive invention. Bearing that distinction in mind, we can obtain guidance as to the nature of the innovations needed by examining how far previous enactments have succeeded in promoting the grant of patents destined to live for a long term, as contrasted with those of inferior longevity: for the latter comprise the less successful originative patents together with the majority of the intensive patents. It must be remembered that in the British and German patent systems, as distinguished from the American, the inferior patents are progressively weeded out by renewal fees, which must be paid on an increasing scale from year to year if a patent is to be kept alive throughout the whole of the available term.

The various factors which might be thought to affect patent statistics can be eliminated only by means of an elaborate analysis, too intricate and tedious to be reproduced here. Such an analysis would leave no doubt, however, as to the effect produced by the Act of 1902, which introduced an official investigation as to the novelty of the inventions patented, the investigation being made for the first time in 1905. As regards the patents destined to live fourteen years, this Act had the effect of raising their number from a fairly steady average in the neighbourhood of 500 to a steady average of about 1200 per annum. On the other hand, it had only a small effect on the number of patents sealed annually, and no systematic effect on the number destined to survive for five years but no longer. The accompanying table gives illustrative figures only. It must be read in the light of the fact that the official examination was first made in 1905.

It will be seen, then, that the effect of introducing some sort of official investigation into the validity of patents before grant was precisely that which a patent system ought to have: the production was stimulated of originative patents having sufficient merit to earn a long life, as opposed to intensive patents and those of inferior quality. The Act of 1883, on the other hand, produced, by a general easing of patent fees, an indiscriminate multiplication of worthless as well as of useful patents.

The effect of the official investigation must be attributed to the enhanced value which was conferred upon patents by increased confidence in their validity, and if we wish to encourage originative inventions, and still more to encourage the exploitation in Great Britain of originative inventions, we must clearly seek some further methods of giving the patentee and his patrons an improved assurance that a patent, when granted by

Year in which patents originated	1902	1907	1913
Number of patents sealed (excluding patents of addition)	15,242	16,172	15,970
Number lapsing after four years	9918	10,625	9385
Number destined to survive for five years only	1497	1441	960
Number destined to survive for fourteen years	596	1175	[1250]*

* Extrapolated.

the Patent Office, shall not run a really serious risk of being found invalid if it should be tested by litigation.

At the present day more than 100,000 British patents are actually in force, and of these, fewer than 250 have ever been tested in the Courts. The Patent Office has investigated their validity so far as certain issues are concerned, but it has made no examination whatever as regards other important issues, and it is probable that a very large number of existing patents are bad in law. The Patent Office does not test the novelty of an invention by searching anywhere but amongst British specifications less than fifty years old, nor does it concern itself with 'prior user' or 'quantum of subject-matter.' Since, then, only a negligible proportion of patents ever have their validity fully tested, the effect of the remainder rests upon bluff. Litigation is so expensive that only the richest patentees dare undertake it, and in this situation the advantage lies entirely with the man of wealth and the large industrial companies. Now it usually happens that in the early stages of a new industry capital is hard to come by: the pioneers have no money to spare for fighting actions in the High Court, so that the high cost of litigation tends to defeat the main aim of the patent system. It favours intensive inventions, which abound in well-established and heavily capitalised industries, but it cripples the comparatively poor nascent industries which are based upon new originative inventions.

The Patent Office, then, cannot assure the patentee of the validity of his patent, because its investigation is incomplete: and the High Court will not assure him of it except at a cost which is prohibitive for men of moderate means. Can nothing be done to remedy

this state of things? A detailed answer to that question would lead us into a highly technical discussion affecting powerful vested interests and admitting of legitimate differences of opinion, but certain broad lines of reform can be indicated as almost indisputably sound.

There is a gap between the legal area investigated by the Patent Office and that which is relevant to the validity of an invention. This gap can be narrowed by expanding the former or contracting the latter area, or both. To take the latter proposal first: it must be admitted that patents can at present be invalidated on grounds which are purely academic and out of relation with practical requirements. In particular, the mere publication of an idea in some long-forgotten specification or journal in a foreign language will invalidate the monopoly of a manufacturer who wishes seriously to establish plant for the practical exploitation of that idea. The law as to novelty, therefore, requires searching scrutiny and reform: it should be borne in mind that mere academic suggestions on paper are of far less service in the establishment of new industries than are the details of a practical method which has been reduced to a commercial basis by exhaustive experiment. Encouragement must indeed be given to the theoretical inventor: but at present he gets more than his share of encouragement as compared with the practical industrialist.

Confidence in the validity of patents can also be improved by extending the scope of the examination made by the Patent Office. In particular, it has already been shown in these columns (NATURE, July 25, 1925, p. 121; Aug. 1, 1925, p. 157) that the investigation for novelty which is made by the Patent Office examiners could, without any subsidy from the State, be made effective over an area equal to that in which the German and American Patent Offices undertake to search. For this purpose it might be necessary to encroach upon the heavy financial surplus which is realised by the British Patent Office every year, but there is no justification whatever for that surplus. So long ago as July 14, 1891, Sir Michael Hicks Beach admitted on behalf of the Govermnent of the day that "he did not think that the country ought to look to the Patent Office as a permanent source of income," but the country has inadvertently done so ever since. Although it has been obtained without raising the pre-War fees, and by means of the admirably economical manner in which the Patent Office has been administered (see page 429 of the present issue), this surplus ought clearly to be used for the benefit of the patentees themselves. It should be remembered that, far from taxing invention, the United States considers it worth while to subsidise its Patent Office.

In the next place, patent litigation can be cheapened by extending the powers of the Comptroller-General and authorising him to deal with issues at present reserved for the High Court. His decisions would, naturally, be subject to appeal: but the poorer class of litigants could be safeguarded by the grant of certificates of validity which would secure them against heavy costs in the event of an appeal; and consequently against the intimidation which is at present practicable. The information obtained by means of a really extensive search for novelty would be of value to the Comptroller-General in deciding questions of 'prior user,' as to which he should also hear evidence. The issue of 'quantum of subject-matter' is entirely comparable with that of 'manner of new manufacture,' of which he is already empowered to dispose: and he might also settle actions for infringement where the damages claimed lie within some moderate limit. That the Comptroller-General and his agents are qualified to carry out these duties is beyond reasonable dispute.

The reforms which have just been mentioned would tend towards enhanced confidence in the validity of the patents granted by the Patent Office, and would diminish the extent to which the poorer are intimidated by the wealthier patentees. They would, therefore, presumably have an effect similar to that of the Act of 1902 in selectively enhancing the production of long-life patents for originative inventions: in this way they would make for the establishment of new industries based on newly created demands, and so would help to solve the unemployment problem. But this effect is conditional on one consideration of great importance. It is a fact that not much less than half of the patents granted by Great Britain are granted to foreigners (*ibid.* p. 428), and the question arises whether such grants tend, on the whole, to promote the establishment of new industries in Great Britain, or to hamper British manufactures in the interest of imports from abroad. The question is of vital importance, since such a very large proportion of our inventions are under foreign control. Legislation in this connexion is subject to various international agreements, but these do not necessarily affect all the participating nations equally, for Great Britain grants a specially large percentage of her patents to foreigners. The existing law makes apparently ample provision against the abuse of patent monopolies by foreigners; but how far it is evaded in practice, and how far its provisions are understood and utilised by British manufacturers, are questions which demand the most scrupulous and painstaking attention on the part of those who are responsible for the solution of the unemployment problem.

Descartes' "Géométrie."

The Geometry of René Descartes. Translated from the French and Latin by David Eugene Smith and Marcia L. Latham. With a facsimile of the first edition, 1637. Pp. xiii + 246. (Chicago and London: The Open Court Publishing Co., 1925.) 17*s.* 6*d.* net.

RENÉ DESCARTES (1596–1650), philosopher and mathematician, is of course universally regarded as the inventor of the method of co-ordinates in geometry; hence the common name for them, Cartesian co-ordinates. Yet, if it were a question of priority, a good claim could be put forward for Fermat (1601–1665), a contemporary, and an even greater mathematician; for, though Fermat's work "Ad locos planos et solidos isagoge" was not published until much later (1679), it was certainly conceived and perhaps written before 1637, the date of publication of Descartes' "Géométrie"; moreover, the method of co-ordinates comes out much more clearly in Fermat, and his analytical geometry generally is much more like ours than Descartes' is. Fermat's share in the new discovery nevertheless remained unknown until quite recent times, and the whole credit was given to Descartes by no less learned a geometer than Chasles, who, in a eulogy which now seems exaggerated, speaks of Descartes' doctrine as "prolem sine matre creatam" and one "of which no germ can be found in the writings of the ancient geometers." Anticipations of the method of co-ordinates are, however, as is now well known, to be found in Archimedes and Apollonius of Perga; the latter stated, for example, in words (without symbols), the fact that the locus of a point satisfying the equivalent of an equation of the first degree in two unknowns is a straight line, and the form in which he states the fundamental property of each of the three conics is the exact equivalent of the Cartesian equation referred to any diameter and the tangent at its extremity as axes. Descartes' actual achievement—and it was momentous enough—was to remove the impasse to which Greek geometry had come through want of notation, by introducing into geometry the unrestricted use of all the resources of algebra (then recently introduced into France from Italy) as a recognised and even indispensable auxiliary.

A mathematician of to-day who should turn to the "Géométrie" in the expectation of finding some sort of introduction to co-ordinate geometry such as is contained in our text-books would be disappointed. As Prof. Loria has observed in a recent study, there is a greater gulf between Descartes' work and a modern treatise on analytical geometry than there is between an ancient (*i.e.* a Greek) and a modern treatise on any other mathematical subject. Descartes uses his new method mainly for the purpose of investigating *loci* of a higher order than conics; he does not, for example, apply it to the geometry of the straight line or the circle. It is strange that the usefulness of the method of co-ordinates for elementary geometry appears to have occurred to no one for a long time. Lagrange saw it and illustrated it in a work published in 1773, but the first systematic exposition of elementary analytical geometry in our sense seems to have been given by S. F. Lacroix as part of his great work "Traité du calcul différentiel et du calcul intégral" (Paris, 1797).

It is not possible within the space of a review to describe fully the contents of the "Géométrie"; we can only notice a few of the outstanding features. Much of the work centres round "Pappus's Problem." This may be shortly stated thus. Given any number of fixed straight lines ($2n$, say, if the number is even, $2n+1$ if it is odd), suppose that from a point (P) not lying on any of them we draw a straight line to meet each of the given straight lines, at given angles respectively; if the lengths of these straight lines l_1, l_2 . . . are taken, and if (when their number is $2n$) the product of n of them bears a given ratio to that of the remaining n, or if (when their number is $2n+1$) the product of $n+1$ of them bears a given ratio to the product of the remaining n and another given length, it is required to find the locus of the point P from which the straight lines are so drawn. The Greeks solved the case of three and four lines (the locus being in general a conic) and also apparently (according to Pappus) one other case, and that not the simplest possible. Descartes in his second book shows how to solve a particular case of five lines, where four of the given lines are parallel and at equal distances and the fifth is at right angles to them, while they are all met at right angles by the straight lines drawn from the point the locus of which is required. Descartes solves this case by means of a curve constructed in a 'mechanical' way. Imagine a parabola and a point (L) fixed on its axis at a certain distance from the vertex. Suppose the parabola to move bodily in such a way that its axis slides on a given straight line, and suppose a ruler to move at the same time in such a way that it always passes through the point L and also through a fixed point A not lying on the straight line on which the axis of the parabola moves. The intersection of the ruler GL with the parabola at any moment determines a point C which lies on a curve of the third degree.

Descartes shows that the point required in the particular case of Pappus's problem lies on a curve of this kind. Again, he constructs two mean proportionals between two given straight lines, trisects any angle, and solves a cubic and a biquadratic equation by using

one *parabola,* along with straight lines and circles, in each case. In his third book (as a final *tour de force*) he solves an equation of the sixth degree in which all the powers of the unknown are present with an absolute term; this he does by means of the intersections of a curve of the kind above mentioned with a certain circle. He does not generally write down or use the equations of the curves as such; like the Greeks, he simply supposes them drawn and then shows that the points of intersection supply a solution of the problem. His solutions, in fact, amount to the Greek procedure carried further by means of the additional resources which the unrestricted use of algebra puts at the disposal of the geometer for the purpose of determining the parts of the figures required. Incidentally, Descartes explains an algebraical method of finding normals to a curve which depends on the principle that, if a circle be drawn with its centre at the point on the axis where the normal meets it and passing through the point on the curve, the circle *touches* the curve at the point instead of cutting it; this means that a certain algebraical equation must have two equal roots, and the use of this fact enables the normal to be determined. Descartes also gives a construction for the normal at any point of the conchoid of Nicomedes without using algebra. He does not say how he discovered it, but it must evidently have been by considering the instantaneous direction of the motion of the point describing the curve, and resolving the motion into two components, in the same way as Archimedes must have determined the direction of the tangent to his spiral at any point, *i.e.* by a sort of anticipation of the differential calculus.

Descartes lays down a number of rules, in regard to the solution of equations, *e.g.* the 'rule of signs,' the method of increasing or diminishing the roots of an equation by any quantity (which enables us to get rid of the second term in an equation), and so on. He explains how, in order to solve a cubic equation, we should first, by considering the several factors of the absolute term, try to find a linear factor, as $x - a$, in the expression equated to zero; and similarly with a biquadratic. In the case of a biquadratic, if the expression equated to zero appears to have no linear factor, it may be possible to separate it into two quadratic factors; by the method of undetermined coefficients Descartes shows that the possibility of this expedient depends on the solution of a cubic in another unknown, y^2, where again we may be able to find a linear factor.

Descartes' notation is interesting. He started the fashion of using the last letters of the alphabet (especially x, y) for unknown quantities. He writes powers from the cube upwards as we do, but generally expresses a^2 or z^2 by aa, zz. He uses the signs + and −; equality he denotes by a sign like that for 'varies as' in algebraical text-books, but turned the opposite way. For the square root he writes $\sqrt{}$, for the cube root $\sqrt{C}$. A horizontal line above an expression serves as a bracket. Where the coefficient of a certain power of the unknown in an equation contains more than one term he writes the terms vertically, one below the other, with a bracket stretching from the top to the bottom.

We congratulate the Open Court Publishing Company on the idea of including this great classic in their series. We would only warn the reader that the translation must be used with caution, as it is in many places inaccurate and sometimes wholly misleading. Two examples may be given. Descartes says that the ancients (*i.e.* the Greeks) were much hampered in their explanations of things by the fact that they scrupled to use arithmetical terms in their geometry; the translators render "le scrupule que faisoient les anciens d'user des termes de l'arithmétique en la géométrie" by "the considerations which forced ancient writers to use arithmetical terms in geometry," giving exactly the wrong sense. In another place Descartes says that, even if a certain change in the conditions were made, "ce point C ne laisseroit pas de se trouver tousiours en une ligne courbe, qui seroit de cete mesme nature," *i.e.* the point C would still always lie ("would not cease to lie") on a curve of the same kind; the translators say "the point C will not always lie on a curve of just the same nature."

The first edition of our treatise was originally published, not separately, but as the last part of the "Discours de la méthode," etc., in which it occupied pp. 297-413. The history of the copy from which the present facsimile was taken is interesting. It was first given by Descartes himself to his friend Letenneur, and it has Letenneur's signature as well as that of Chasles. Chasles gave the volume to Sylvester, who gave it to George Bruce Halsted, who again gave it to C. I. Palmer of Armour Institute, Chicago, by whom it was made over to the publishers.

T. L. H.

The Origin of European Culture.

The Dawn of European Civilisation. By V. Gordon Childe. (The History of Civilisation Series.) Pp. xvi+328. (London: Kegan Paul and Co., Ltd.; New York: Alfred A. Knopf, 1925.) 16*s.* net.

ADVANCE in our knowledge of the various stages of prehistoric culture in Europe has never been uniform. This was necessarily the case in the earlier days of archæological investigation, when the material was drawn to a large extent from chance discovery.

Even now systematic exploration can be pursued only to a relatively limited degree, and fortune may at any moment bring to light evidence which will affect fundamentally our conceptions of the course of events in any given area at some particular point of time. It is, however, a remarkable, but not necessarily a surprising, fact that our knowledge of the neolithic and succeeding phases of the prehistoric period, but especially the neolithic, should so long have lagged behind that of the palæolithic stage. It is not surprising, if only because the high antiquity of palæolithic man and the mystery of his phylogeny have appealed strongly to the imagination, and this has tended to stimulate and systematise research. Greater attention, it is true, is now paid to the period immediately following the palæolithic and the break in continuity, which it was once imperative to recognise, has been filled by the culture of the epipalæolithic or mesolithic age. But in the neolithic age itself and in the later periods, although there is no lack of material, frequently the conditions of discovery in surface finds or in isolated hoards and caches have precluded the study of the material in its more precise chronological relations, which is necessary for the full understanding of the lines of development and the trend of events.

The greatest check on progress in the study of later prehistoric times has been the lack of anything like a comprehensive survey of the material as a whole which would have attempted to systematise our knowledge at any given moment, and to indicate the gaps which should be filled by future research. The time is now ripe for some such comprehensive study, if, indeed, it is not overdue. Much is still obscure; and the important investigations of archæologists on sites themselves well known but often isolated, have still to a large extent to be brought into relation. For the epipalæolithic period much has been done, and gradually from the material which is accumulating from North Africa, Spain, southern France, the Baltic, eastern Europe, and even to a limited extent from Great Britain, it is becoming possible to build up a picture of the movements of culture and more dimly of peoples directly ancestral to modern Europe. Further, in the Mediterranean area the researches of Sir Arthur Evans and others in Crete and in Greece, by demonstrating the relations of Minoan Crete to Egypt, to Asia Minor, and to Libya, and between Crete, the Ægean and the Greek mainland, are establishing something like a trustworthy absolute chronology for this area which ultimately will serve at once as a touchstone and a divining rod for the rest of Europe as it becomes possible to work out in detail the interrelation of the various centres of culture.

It has been necessary to dwell at some length upon these conditions in which intensive study of certain areas and sites has been accompanied by too general a lack of correlation of results as a whole in order to emphasise the special merit and the value of Mr. Childe's "Dawn of European Civilisation." It is the first attempt to summarise and evaluate the evidence relating to the various problems of the later stone and early metal ages as a whole. It follows the development of culture as we know it in each of a number of centres—Crete and the Eastern Mediterranean, Hissarlik and the coasts of Asia Minor, the Western Mediterranean, Spain, the Steppes, the Black Earth region comprising the Ukraine, Eastern Galicia and Rumania, the Danube, Scandinavia, "where east and west meet," the Baltic, eastern Germany and Poland, the lake dwellings of Central Europe and the culture of the Alps, the Atlantic seaboard, with its megalithic culture, and Great Britain. Mr. Childe, takes his readers from the epipalæolithic down to about the middle of the Bronze Age. In his preface he gives his reasons for thus setting the limits of his subject and defines his theme as "the foundation of European civilisation as a peculiar and individual manifestation of the human spirit." With the genesis of the common substratum of human culture, therefore, he is not concerned. At once, however, he finds himself confronted with the problem of the origin of this civilisation with which he deals. Does it come from the Ancient East, or are all the elements of this culture to be found in Europe itself? Mr. Childe modestly deprecates the attribution to him of an attempt to present a final synthesis. He lays claim to nothing more than "an earnest attempt to survey all the facts as a whole." In the end he seems on the whole to incline to the former view. The evidence he adduces certainly is in favour of those who look to the East, and it points to south-eastern Europe as the line by which the distinctive forms of early culture have come to the centre and west.

In attaching the importance he does to the culture of south-eastern Europe, Mr. Childe holds what is both strategically and tactically the inner position. His conclusions are to a great extent based upon, and coloured by, his intimate knowledge of the culture of Erösd and neighbouring sites in the valley of the Alt, which is described here for the first time in English. Erösd is a site in the Alt Valley in Transylvania just west of the Carpathians, which lies in the Black Earth country, so called from the fertile deposit which overlies the loess, a site eminently suitable for early agricultural settlers to whom the oldest traces here of postglacial habitation are due. It was explored by the late Dr. Ferencz Laszlo, who brought to light remains of a high civilisation of the type which appears as an intrusion in Thessaly. The people of the Black Earth

region produced a painted pottery, the ware of the Tripolje culture, which has led some archæologists to hope that these earliest inhabitants of the area might possibly be linked up with the early peoples of Mesopotamia, Elam, Anau in Turkestan, and their pottery brought into relation with the remarkable and characteristic painted pottery of these sites, which seems to extend as far afield as Honan in China. Mr. Childe holds that the culture of the Alt is the earliest in the Danube basin, and would regard it as the source of the culture known to archæologists as Danubian I. He has, however, no certain suggestion to offer as to the origin of the Erösd culture. So early a civilisation of high standard, with its knowledge of grain, painted pottery, copper and gold, offers a problem to the archæologist which is as dangerously tempting as it is momentous. Mr. Childe is fully alive to the dangers of over hasty attribution of an eastern origin, and with a fine impartiality points out the obstacles in the way—difficulties arising from both style and technique.

It would be tempting to follow with Mr. Childe the spread of Danubian culture along the Rhine into Belgium and France, of the culture of the Mediterranean into Spain, and the spread of the megalith along the Atlantic coast, but enough has been said to indicate the scope and quality of his book. Its extraordinary and, indeed, almost marvellous grasp of an enormous mass of detail, and its breadth and sanity of view in dealing with the larger problems, as well as the acute and critical judgment of the author, combine to make the "Dawn of European Civilisation" a contribution to prehistoric archæology of first-rate importance which will have a profound effect on future lines of study and research.

Chemical Aspects of Life.

Lectures on Certain Aspects of Biochemistry. These Lectures were given in the University of London during the Summer Term, 1925. By Dr. H. H. Dale, Prof. J. C. Drummond, Prof. L. J. Henderson, Prof. A. V. Hill. Pp. viii+313. (London: University of London Press, Ltd., 1926.) 12*s.* 6*d.* net.

THE attempt to interpret the phenomena of life in terms of chemistry resolves itself in practice largely into the study of the mutual reactions between living and non-living matter. Living cells exhibit the remarkable property of exerting chemical action upon certain components of their environment, and of assimilating and ultimately of obtaining energy from them. The terms 'machinery' and 'fuel' are often used—loosely, it must be admitted—to distinguish the assimilator from the assimilated, though there is evidence that the two are to a certain extent mutually replaceable, structural parts disintegrating to supply energy, and energy-holding materials being built up into the structure. The analogy is, however, quite a useful one so long as it helps us not to forget that the chemical phenomena of life are quite as much attributes of a particular physical state of matter as of a particular chemical structure. Both considerations are important, for life, like a flame, is a temporary shape set to an unceasing flow of matter of peculiar properties.

Life as a state of matter involves the conception of conditions of equilibrium which can only be maintained with expenditure of energy . . . it costs us something merely to exist, in more senses than one. The more delicate the state of balance, the more numerous and potent are the conditions which modify it.

The investigation of the chemical relationships of the equilibrium which is life is the main concern of biochemistry; for the equilibrium itself involves chemical reactions, and is subject to modifications by various chemical influences both from without and from within the cell. Advance in biochemistry, as in other sciences, is largely conditioned by the methods which are at hand for its pursuit. It follows, therefore, that while its main objectives are unaltered, certain aspects of biochemistry show periodic developments as a consequence of advances in the cognate sciences, or of special developments of technique which open up new lines of attack upon its central, unalterable, and perhaps insoluble problems.

The central mystery of life, from the chemical point of view, concerns the means by which oxidation and so energy liberation is effected, and it is fitting that such exponents of animal physiology as Dr. H. H. Dale, Profs. J. C. Drummond, L. J. Henderson, and A. V. Hill should present to us various chemical aspects of this fundamental problem. The control of the circulation in the capillary blood-vessels is a subject which owes much to the researches of Dr. Dale and his colleagues. The flow of blood to the tissues is largely controlled by chemical means in accordance with the need of the tissues for oxygen, more or less blood being made available by dilatation or by constriction of the capillaries.

One of the perpetual problems of biochemistry is the manner in which the living cells are enabled to satisfy their energy requirements by carrying out at low temperatures oxidative reactions which in the laboratory often necessitate the employment of high temperatures and powerful reagents. A considerable step in the elucidation, or perhaps, rather, in the transference to a different plane, of this problem, has been made of late, and has been discussed by Prof. J. C. Drummond. Two ideas have been introduced from the realm of pure chemistry, the importance of

small amounts of inorganic catalysers, chief among which appears to be iron, and the part which is played by hydrolytic oxidation-reduction reactions and oxidation by dehydrogenation. Closely bound up with both of these questions is the rôle played by glutathione, and by inorganic and organic phosphates.

In the carriage of oxygen and carbon dioxide, the blood has long been known to have essential functions, but it is only recently that the researches of Prof. L. J. Henderson, of Harvard, have shown us by what a beautiful physico-chemical mechanism the functions of the blood in this respect are controlled. In reading his three lectures, one not only finds much new physiology, but one also appreciates that the subject is capable of exact mathematical treatment. The study of the means by which the blood adjusts itself to alterations in the external environment, and thus maintains constancy of the internal environment of the cells, has proved to be a very profitable one indeed, in the physiology of biological integration.

The environment of the living cell is naturally a matter of fundamental importance, and we are often apt to forget, as Prof. A. V. Hill says in his lecture, that in systems of such small dimensions, the alteration of the scale necessitates alteration in other scales, such as the time-scale, as well. Diffusion, for example, which we are inclined to regard as a very slow process, may occur with such relative rapidity as to modify the chemical reactions very considerably. Among the chemical reactions which take place in living cells, the formation of lactic acid, which Prof. Hill discusses in another lecture, is a very fundamental one. There seems to be little doubt that the formation of this substance, and its subsequent oxidative removal, stands in the most intimate connexion with the phenomena of muscular contraction.

Another focal subject in biochemistry is that of growth and nutrition, and the lecture by Prof. Drummond on the phosphates and on the vitamins shows how much has been accomplished in recent years in this direction. The establishment of vitamin D, which plays such an important part in the formation of bone, the relation of this to the action of ultra-violet light, and the part played by phosphates in the calcification of bone, all appear to be connecting up to form a new and most valuable chapter in physiology.

The proper integration of the various functions of the body is effected in various ways, Nature using any means at hand to achieve this result; the chemical co-ordination by means of the hormones is one means of great importance, and Dr. Dale treats of recent investigations of two hormones, the pituitary principles, and insulin.

One leaves this book with the feeling of having not only read matter of first-class importance, but also of having had it presented in an altogether fascinating manner. Biochemistry has certainly done much to deserve the high esteem in which it is held to-day.

Neoplasms.

(1) *The Nature of Tumour Formation: the Erasmus Wilson Lectures delivered before the Royal College of Surgeons of England, on Feb. 23rd, 25th and 27th, 1925.* By Dr. G. W. Nicholson. Pp. xviii + 99. (Cambridge: W. Heffer and Sons, Ltd.; London: Simpkin, Marshall and Co., Ltd., 1926.) 6s. net.

(2) *Malignancy and Evolution: a Biological Inquiry into the Nature and Causes of Cancer.* By Morley Roberts. Pp. 319. (London: Eveleigh Nash and Grayson, Ltd., 1926.) 18s. net.

THE mystery of new growths, their nature, treatment, and the possibility of prevention, has aroused more interest recently than at any other time in the history of medicine. For some years it has occupied the attention of research workers in every field probably more than any other of the great problems of disease. Innumerable facts and data concerning the subject have been recorded, yet we seem to be little nearer its solution than we were at the close of the last century.

(1) Dr. G. W. Nicholson, in the Erasmus Wilson Lectures of 1925 on "The Nature of Tumour Formation," has no new facts to place before us and no fresh discoveries to disclose. He brings what in our present state of confusion is of far more importance, a fresh point of view. Commencing with his own histological observations, which may be confirmed by any one with microtome and microscope, he attempts to establish a sequence of events of which the tumour is the last. He regards neoplasms as malformations arising in previously healthy tissues. All living cells possess the property of growth, and there is evidence that the power of multiplying to an excessive degree is potential in every healthy cell. Dr. Nicholson considers every tumour to be a manifestation of this excessive growth, to which absolutely healthy cells have been stimulated by some change in their environment. He sees in every cell of the new growth an effort on the part of that cell to be normal, *i.e.* physiological, in structure and function, and where it fails to be so, there is some inhibiting accident of position or environment, such as the absence of appropriate physiological stimulus to differentiation. It is in this point that his explanation differs from the theory of growth habit, in which it is postulated that the cells abandon their function for the purpose of proliferating.

In attempting a scientific explanation of neoplasms, Dr. Nicholson has disregarded all theories, perceiving that they are based on pure speculation. It may be alleged from some quarters that he has merely enunciated a new theory, but such a comment would be quite unjust. He has simply shown that in the sequence of events leading up to tumour formation, certain things happen in accordance with the general principles of physiology, biology, and embryology. With the reason for these happenings he is not concerned; little reference, mainly in an appendix to these lectures, is made to the nature of the change of environment which stimulates cells to proliferate, and in this connexion it is of interest to note that parasites are considered to be among the possible factors which can produce such a change.

It is evident in this book that one of the most important reasons for our failure to understand new growths is the lack of co-operation between the pathologist and the biologist. The former is blamed for his ignorance of the biological views concerning the constitution of living matter; the latter is criticised for his lack of appreciation of tissue reaction and adaptability under conditions familiar to every pathologist.

(2) With these censures in mind we turn with interest to the effort of the philosopher, untrained in the medical and allied sciences, to co-ordinate the observations of scientists and by reasoned thought to bring order out of chaos. Mr. Morley Roberts has approached the problem as an expert in no science save sociology, having to work on material provided entirely by others, and being at the outset of his researches quite unfamiliar with the structures and processes he proposed to investigate. Yet these apparently insuperable obstacles have by their very nature given him an enormous advantage over the scientific investigators, who, following their own isolated lines of work and thought in biology, pathology, or physiology, have attempted to solve mysteries requiring for their elucidation a clear perception of all three. We have previously had evidence that Mr. Roberts has mastered the general principles of these subjects, has acquired a sound knowledge of anatomy and histology, and possesses that clarity of thought which enables him to correlate the various features of the problem he sets himself. "Malignancy and Evolution" is a worthy successor to "Warfare in the Human Body."

In this work the author extends the views advanced in his previous book to cover the development of new growths. The aspect of the human body as a community similar to societies and nations, with tendencies to be checked and laws to be obeyed, leads him to conclusions very similar to those advanced in "The Nature of Tumour Formation." Aided by social analogies, he sees variation and disease as a breakdown of settled order, and concludes that disease and repair are essential factors of evolution. Neoplasms are regarded as manifestations purely of growth, resulting from the same mechanism which produces the liver and kidneys In this book we find suggestions as to the nature of the environmental changes causing cell proliferation; it is supposed that the community controlling factors are in a state of unrest and instability by reason of the rapid evolution of the race, and that this naturally results in variation and breakdown as it would in the life of a nation.

The author expresses acknowledgment for assistance in practical details to various scientific workers, including Dr. Nicholson; but the reasoning is entirely independent, and their conclusions concerning the actual mechanism of tumour development are related only in being confirmatory of one another. Mr. Roberts's views are well worthy of the attention of biologists and pathologists, and he is to be congratulated on the result of his efforts to shed light on a question of greatest importance to the human race.

Our Bookshelf.

Emotion and Insanity. By S. Thalbitzer. Translated by M. G. Beard. (International Library of Psychology, Philosophy and Scientific Method.) Pp. x + 128. (London: Kegan Paul and Co., Ltd.; New York: Harcourt, Brace and Co., Inc., 1926.) 7*s.* 6*d* net.

DR. THALBITZER'S book is a psychological essay the material for which is provided by a study of the manic-depressive psychosis. It is a brief attempt to explain certain mental phenomena on a physiological basis. The author first considers the generally accepted division of mentation into the psychical elements of thinking, feeling, and willing, a classification which he rejects in favour of that of intellectual activity, feeling, and psycho-motor innervation. He thus defines the mind as that which thinks, feels, and acts. It is with the element of feeling that this book is mainly concerned. It is submitted that this function must, like the other two specific functions of the mind, have its own centre in the brain, a postulation which involves Dr. Thalbitzer in a very damaging and convincing criticism of Lehmann's dynamic theory of emotion. The suggestion that this localisation is in the occipital lobes, and the evidence offered in support of it, do not carry so much conviction, but they are comparatively minor points.

Dr. Thalbitzer's physiological explanation of emotion is based on three well-recognised physiological laws. The application of the law of specific energy of cells isolates the element of emotion to one definite part of the brain. The law of tonus, or continual functioning of cells, explains the presence in every psychic process of all three elements of the mind, a fact well emphasised in the mood-psychosis, where any of these elements may function to an abnormal degree. The law which

limits the variation of function of a cell to increase or decrease confirms the observation that the differences between various feelings are quantitative.

Whatever the view taken of this fascinating explanation, there is one plea in this book which must be whole-heartedly endorsed. It is that psychiatric research should receive much more consideration in the effort to determine the nature of normal mental processes. The services rendered to physiology by pathology are well known; in the sphere of the nervous system and neurology they have been of first moment. Yet, apart from the very dubious conclusions drawn from the study of the hysteric and neurasthenic, psychology has learnt little from observation of the mentally abnormal. Perhaps this reproach applies more to psychology in England than elsewhere; in no other country is better provision made for the care of the insane; the field for research is correspondingly greater. If the hint from the Danish psychiatrist is taken, psychology may make even more progress during the next decade than it has in the last.

The 'Eötvös' Torsion Balance. Pp. 90. (London: L. Oertling, Ltd., n.d.) 21*s*.

WHEN a scientific instrument assumes a commercial value beyond its intended scientific use, trustworthy and detailed descriptions of its construction and of the method of its operation become scant if not altogether inaccessible. This class of instrument includes the Eötvös torsion balance, designed in 1888 by the Hungarian physicist, Roland Eötvös, for analysing the local anomalies produced in the normal gravity conditions by tectonic and geological abnormalities. Of this period, extensive literature is available both as regards construction of the balance and the results of measurements. But since the torsion balance proved to be one of the most useful instruments available for the location of mineral ore deposits, and a considerable refinement has been achieved in its design, trustworthy sources of information and details, from which an independent judgment could be drawn, have been deplorably lacking. The commercial necessity of secrecy by users of the torsion balance renders valuable observational data inaccessible for an indefinite period. The present book is the first comprehensive treatise on the balance published in any language, and it presents a host of informative details.

The subject is treated in two parts. Part 1 presents the theory of the balance, the derivation of working formulæ, the method of making observations, the relationship of the quantities derived, the classification of gravitational effects and computation and elimination of normal, terrain, and topographical effects. The second part embodies notes on the practical employment of the balance and recommends itself particularly to the physicist operating the instrument. These two parts, which comprise three-fourths of the book, constitute a concise and broad treatment of the balance and apply to any model of the instrument. The third part gives a description of the Oertling model, in which instrumental details are described and illustrated with commendable candour.

This book is no touchstone whereby, with the aid of the instrument, valuable mineral deposits or oil domes can be located in a trice. The collection of observational data is routine after preliminary training, but the rational elimination of effects extraneous to those of the deposit sought and the correct interpretation of the results thus obtained are problems of considerable difficulty calling for skill and extensive geological experience. Yet even in these difficult matters, this book offers a safe and instructive preliminary guide. Messrs. Oertling and the authors are to be congratulated on producing this well-bound, well-printed and arranged pioneer text-book on the Eötvös torsion balance, a subject the treatment of which on the lines here adopted has been long overdue.

E. R. F.

A Psychological Study of Immigrant Children at Ellis Island. By Dr. Bertha M. Boody. (Mental Measurement Monographs, Serial No. 3.) Pp. vi+163. (Baltimore, Md.: Williams and Wilkins Co.; London: Baillière, Tindall and Cox, 1926.) 18*s*. net.

EXAMINATION of immigrants at Ellis Island has been stimulated by fervid political propaganda maintaining that north-western Europe is better than south-eastern, and by sob-stuff propaganda dilating the hardships of those rejected by the apostles of eugenics. Mental measurements now permit exact inquiry.

Those more than sixteen years of age are expected to read. The Army 'Alpha' test seems to show the superiority of the north European, but in terms of Army 'Beta' the Latins are less inferior. The problem has been to invent new forms of performance tests which can be set in dumb show to a mixed group "of an Arab, a Greek, an Italian, a Welsh boy, an Armenian and a Russian. The members of such a group do not talk together; but they laugh together and spur each other on" (p. 103). The invention of such tests running smoothly and in silence without pencil or interpreter has been the great achievement (p. 132). Picture completion, form board, button holes, drawing stars, Binet weights, card sorting, bow knot are among the tests used.

The conditions of the examination are not ideal. Imagine a crowd of children of all ages, unequally seasick, exhausted, frightened, excited. What "recognition of the general emotional upset" would they demand? Attendance at the Island school is optional, and there is much interruption.

The tentative conclusion is that there are great differences, but that these differences are individual and not traceable to ancestral race or state nationality. But the numbers tested—27 Germans, 22 Armenians, 27 Hebrews, 15 Poles, 19 Italians, etc., of divers ages—seem too small to admit of any conclusion.

Chinese, Japanese, and Indians do not appear on the eastern seaboard. If the immigrant Irish are a mixed sample, it must not be assumed that they are a fair sample of those left behind in Ireland or that the sampling will not change as they segregate and settle industrially.

The direction of progress seems to be in examination at the home port of departure, maintaining exclusion of lunatics and deficients, and reliance on mental measurements rather than national quotas.

The book may be commended to schoolmasters, missionaries, and employers of native labour.

HUGH RICHARDSON.

Directions for the Dissection of the Cat. By Prof. R. P. Bigelow. Pp. xii+47. (New York: The Macmillan Co., 1925.) 4*s.* net.

THE directions for the dissection of the cat are here so arranged that the whole operation may be carried out on a single specimen, and the aim of the book is to give the student a clear survey of the organism as a whole and not as a system of organs. With this end in view, the dissection starts with the skin and muscles of the ventral body wall and works steadily through to the spinal cord and brain. Organs and structures are dealt with as they appear in the course of such a dissection and not in systems. The directions are clear and concise; necessary emphasis on particular points is given by heavy type, and the drawings which it is desirable for the student to make are indicated in their proper place and sequence. A useful introductory chapter gives valuable information on the preservation, embalming, and injection of material. The author believes that the dissection of the cat is a very desirable introduction to a course of human anatomy and physiology, and would be a valuable part of pre-medical studies: also that the size of the animal and the ease with which it can be obtained make it a favourable object for such studies. In such circumstances this book would be of considerable service, but the absence of any figures limits the value of the book and necessitates its use only in conjunction with standard works on the anatomy of the cat which are adequately illustrated.

The History of Arithmetic. By Prof. L. C. Karpinski. Pp. xii+200. (Chicago and New York: Rand McNally and Co., 1925.) n.p.

THE purpose of Prof. Karpinski's book is to present the development of arithmetical knowledge as a vital part of the history of civilisation. Particular attention is paid to the material of arithmetic taught in American elementary schools and to the historical phases of that work with which the teacher of arithmetic should be familiar. The book also contains a bibliography of the early American text-books of arithmetic printed before 1800, and refers to many of the early popular treatises on the subject used in England.

The volume is mainly intended to appeal to a popular audience desiring some acquaintance with the development of arithmetic from the earliest times. Prof. Karpinski gives a very entertaining account, based on the larger treatises of T. L. Heath, T. E. Peet, and D. E. Smith, of the progress of arithmetical knowledge from ancient Egyptian times until the present day. He also gives many carefully chosen diagrams which add interest to the theme. Most school libraries would be enriched by a copy of the book.

A Practical Handbook on Rat Destruction. By C. Leopold Claremont. Pp. vi+180+6 plates. (London: John Hart, n.d.) 3*s.* 6*d.* net.

THIS book deals in an exhaustive and essentially useful manner with the problem of the rat. A brief introductory chapter on the characters and habits of the brown and black rats is followed by an account of the destruction of rats by trapping, hunting, and the use of gas, and of the various poisons most effective for the purpose. These chapters are very exhaustive and of great practical value. The author then deals with the Rats and Mice (Destruction) Act of 1919, and discusses in detail its various clauses and the responsibilities of owners, local authorities, and the Ministry of Agriculture in carrying out its provisions. He pleads for more whole-hearted co-operation between these parties in combating the rat menace. Chapters on the relation of the rat to public health and disease, and on a general survey of what has been done and what may be done in the matter of rat control, conclude a very useful book, which should be of great service, particularly to those officers of local authorities whose duties include the enforcement of the laws relating to the destruction of these pests.

Travel and Travellers of the Middle Ages. Edited by Prof. A. P. Newton. (The History of Civilization Series.) Pp. viii+223+7 plates. (London: Kegan Paul and Co., Ltd.; New York: Alfred A. Knopf, 1926.) 12*s.* 6*d.* net.

THE contents of this volume, which is one of the series appearing as "The History of Civilization," is a course of lectures delivered in the University of London. The book does not profess to be a complete survey of the subject, but several of the lectures have been expanded and the editor has added an introduction on the conception of the world in the Middle Ages. The twelve chapters are by various writers, including Prof. M. L. W. Laistner, Prof. Claude Jenkins, Sir T. W. Arnold, Baron A. F. Meyendorff, Prof. E. Prestage, Sir E. D. Ross, Prof. A. Mawer, and Dr. E. Power. Those on Christian pilgrimages, Arab travellers, the routes to Cathay, and Prester John may specially be noted. Prof. Mawer, whose contribution on the Vikings has no references to authorities, apparently accepts the Norse voyages to Vinland, and does not mention the researches of Nansen and others with their conclusion that Vinland was a myth. The book has a few illustrations, but only two maps.

The Borderland of Music and Psychology. By Frank Howes. Pp. x+244. (London: Kegan Paul and Co., Ltd.; J. Curwen and Sons, Ltd., 1926.) 6*s.* net.

"ART and intellectual speculation are the two exceptional realms of the mind of which the psychologist finds it most difficult to give an account" (p. 147). Too much has been expected from psychology since it presumed to stand in its own right as an experimental science. Many who looked to it for immediate solution of age-long problems disappointedly turn away as from a charlatan. In doing so the valuable little that it already has to give is lost. The author, with sympathetic knowledge of current musical and psychological theories, has given a capable preliminary survey of an interesting no-man's-land lying between suspicious armed camps. If at times he laughs at both from the exalted heights of philosophy, we forgive him, for he never loses himself in the realm where the problem is of more importance than its solution, but ever returns to his theme with notes such as: "But this is not science, nor even musical criticism" (p. 142); "We step beyond psychology when, after saying what musicians and audiences do, we ask, 'What is music?'" (p. 40).

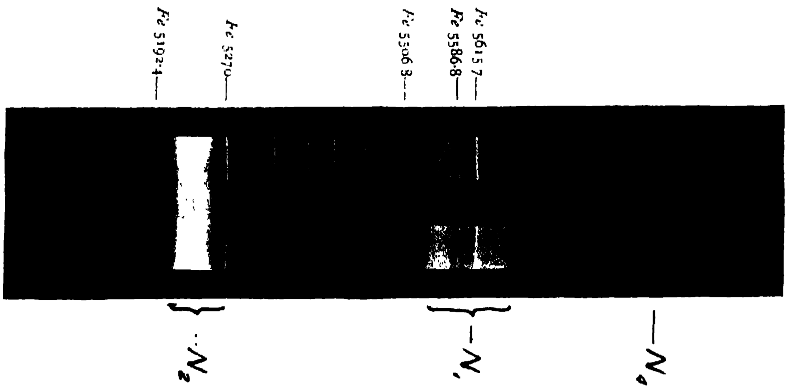
R. J. B.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

On the Phosphorescence of Nitrogen.

BY the use of a tube of a type recently designed by Dr. Coolidge of Schenectady, and kindly shown in action by him to one of us, we have recently been



enabled to extend our knowledge of the spectrum of solid nitrogen made luminescent by bombardment with swiftly moving electrons. The tube we used was provided with a window of thin nickel foil through which electrons under a potential of 125,000 volts were projected into the vacuum space of a german silver thermos flask of special design. The nitrogen was deposited and solidified on the inner wall of the thermos flask within the vacuum space, and the refrigerant used was liquid hydrogen.

The luminescence of the solid nitrogen was observed in our experiments through a fluorite window in the outer wall of the thermos flask, and its spectrum was photographed with glass quartz and fluorite spectrographs. All wave-lengths measured and given below are in Ångström units.

Photographs of the spectrum of the light emitted while the solid nitrogen was being bombarded showed :

1. A single sharply defined narrow band (N_4) at λ 5945.
2. Three broad diffuse bands (N_1) shading each into the other with mean wave-lengths of approximately λ 5554, λ 5617, λ 5658.
3. A series of eight clearly defined bands (N_2) with the wave-lengths λ 5204·4, λ 5210·4, λ 5214·3, λ 5220·4, λ 5224·4, λ 5228·8, λ 5235, λ 5240 ; and
4. A number of faint diffuse bands each shaded off towards the red in the blue and violet spectral region between λ 4500 and λ 2460. Very approximate wave-lengths of the heads of these bands were found to be λ 4575, λ 4500, λ 4270, λ 3990, λ 3725, λ 3510, λ 3385, λ 3155, λ 2960, λ 2785, λ 2615, λ 2460. As regards these bands, some have been observed by Vegard already, and some, at least, appear to belong to the well-known second positive band spectrum of nitrogen.

Among a number of interesting results obtained by us, four are worthy of special note :

1. We failed to record on our plates, with twenty hours' exposure, any trace of a group of wave-lengths designated by Vegard as N_3 that were found by him to include one band at λ 6569, and one with its maximum intensity between λ 6320 and λ 6420. In this connexion it might be stated that our plates were highly sensitive up to λ 7000.
2. When the tube was in action and the solid nitrogen was strongly luminescent, we always found by visual observation that when the bombardment was interrupted, the wave-lengths of the group N_1 immediately disappeared from the radiation emitted by the luminous nitrogen, while the red band N_4 and the bands N_2 between λ 5204·4 and λ 5240 persisted some minutes, often very brilliant, but with slowly weakening intensity. Vegard has suggested that the groups N_2 and N_4 belong to the phosphorescence spectrum of solid nitrogen, and, as will be seen from the results given above, our experiments confirm this view.
3. As to the group of three bands N_1, we found that they were relatively strong when the solid nitrogen under bombardment had been freshly deposited. But with prolonged bombardment of a given layer of solid nitrogen, the intensity of the group of wave-lengths N_1 rapidly weakened and finally was scarcely sufficient to make the radiation observable. The intensities of the band groups N_2 and N_4, on the other hand, appeared to be unaffected by prolonged bombardment. Since exposures of long duration were required in photographing the complete

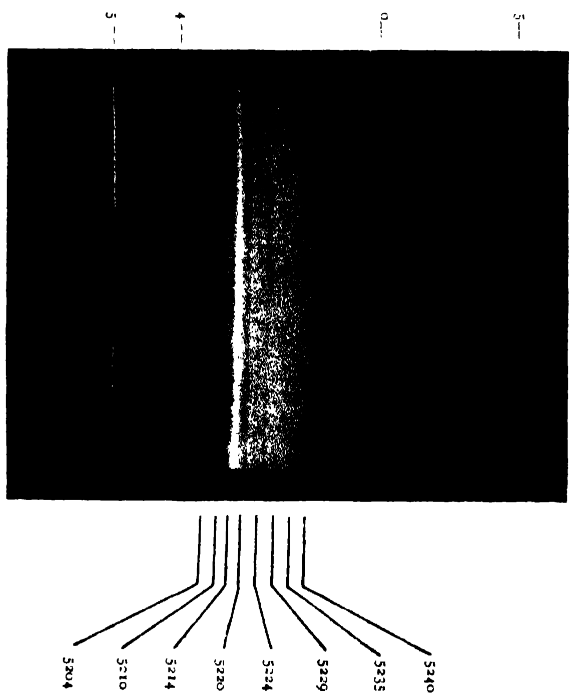


FIG. 2.—Band N_2.

luminescence spectrum, it was necessary therefore to deposit a fresh layer of solid nitrogen approximately every half-hour.

From these results it is clear that two spectra are obtainable from solid nitrogen, one of which includes the band group N_1, and the other the bands N_2 and N_4. This would go to show that solid nitrogen can exist in two forms A and B, the one, A, emitting the radiation constituting the band N_1, and the other, B, the radiation constituting the band groups N_2 and N_4. Our experiments support the view that the solid nitrogen is initially deposited in the form A, and that under electronic bombardment, and possibly otherwise, it is soon transmuted into the form B, this form B being the one that exhibits the phenomenon of phosphorescence.

4. The band group N_2 as originally observed by Vegard and by McLennan and Shrum, consisted of a single sharply defined narrow band at approximately λ 5230. This band has been found, however, to be more extensive than was originally supposed, for, as shown above, it is now known to consist of at least eight strong and well-defined members. Since no band of anything like this character has ever been shown to be a feature of the spectrum of the aurora, in the neighbourhood of λ 5230, it would appear that Vegard's theory that finely divided solid nitrogen exists in that portion of the upper atmosphere where auroral displays originate is not tenable.

The bands N_1, N_2, and N_4 are shown in Fig. 1, and the bands N_2 in Fig. 2.

J. C. MCLENNAN.
H. J. C. IRETON.
K. THOMPSON (Student of Canadian National Research Council).

The Physical Laboratories,
University of Toronto, August 20.

Polarisation of Wireless Waves.

IT is now generally accepted that many of the phenomena of wireless reception are caused by the interference between two waves, one of which has received reflection or refraction in the upper layers of the atmosphere. Considerable evidence is also now forthcoming of a fact which was suggested in earlier days; namely, that the reflection is not simple but that a vertically polarised incident wave may be returned with polarisation of a much more complex form. On this are based explanations of night variations in bearing, fading, and similar phenomena; and the subject has also been discussed theoretically by Appleton, Hulbert, and Nicholls and Schelling.

These investigators have confined their attention chiefly to wave-lengths of a few hundred metres at most, and there have been doubts as to whether the longer waves were affected in a similar manner. In a previous paper (*Journal I.E.E.*, No. 353, page 587) the present writer has referred to the elaborate but regular intensity variations occurring at medium distances on long waves during the sunset period, and recent experiments have shown that the cycle given by the transmissions from Sainte Assise (UFT) on 14,350 metres at Slough on page 587 is regularly accompanied by a definite cycle of bearing variation differing slightly in intensity from day to day, but always possessing the same general form. Variations of bearing of as much as 35° have been observed at times, showing that the departure from vertical polarisation must have been large.

Measurements were, therefore, made to see if any quantitative deductions could be made from these results.

Although it is theoretically possible to make use of bearing variations for such a purpose, the accuracy of observation is low owing to the non-silent minima which often occur, and it was found preferable to take three measurements of absolute electrical intensity: (*a*) in the plane of propagation; (*b*) in a vertical plane at right angles to this; (*c*) in any convenient intermediate plane from which the results can equally well be deduced.

In some cases it has been found that the intensity (*b*) actually exceeded the intensity (*a*) for short periods.

Now, in the general case of elliptic polarisation these results do not admit of any further solution, but by making the further assumptions: (i.) that second reflections are not present; (ii.) that the downcoming wave remains plane polarised but that the plane of polarisation is rotated, it is possible to deduce figures for this angle of rotation and for the coefficient of reflection.

Observations taken at Slough and Exeter under these conditions show that during the sunset period a rapid rise in the coefficient of reflection occurs and also a rotation of the plane of polarisation of at least 90°, most of which persists throughout the night. It remains to be verified whether assumptions (i.) and (ii.) are justifiable, though there is evidence in their favour; but the two chief facts which emerge from the tests are independent of them. These are:

I. Long waves as well as short may be elaborately polarised by refraction in the upper atmosphere during the night.

This effect is also present, though in a less degree, during daylight in the winter, and occasionally even during daylight in the summer.

II. The effect persists during the hours of darkness, remaining fairly steady after the sunset period is over; and consequently it cannot be caused by the mere temporary displacement of the reflecting surface from its normal horizontal position owing to the ionic recombination which occurs at sunset; but must be an essential feature of the mode of refraction.

Further experiments on this point are in progress, but as the solution requires the construction of a vector triangle the conditions have to be very carefully chosen in order to avoid indeterminate figures due to the limitations of the geometrical process. The experiments referred to above were carried out for the Radio Research Board of the Dept. of Scientific and Industrial Research. J. HOLLINGWORTH.

National Physical Laboratory,
Teddington,
August 31, 1926.

Plastic Deformation of Single Metallic Crystals.

NATURE has published two letters from Mr. S. J. Wright and Dr. Goucher respectively (June 26 and July 31) in reply to ours of May 22 on the wedge formed when a single crystal of a metal is broken in tension. We desire in reply to stress most strongly the fact that our analysis of such a wedge is concerned with the final position of an atom after movement and has no reference to the path or the mechanism by which it arrived there. This concerns directly both of the communications.

Mr. Wright's insistence on the fact that the wedges examined by him were bounded by curved surfaces, means no more than that the ultimate displacement of the atoms of his test-pieces was greater in some localities than in others and has no bearing whatever on the validity of our treatment. His remarks *re* hard spheres are similarly wide of the mark, since we have not made assumptions of any kind as to the mechanical properties of the atom in its response to the stress.

Dr. Goucher's letter, however, is worthy of more serious consideration. His statement that our formula presupposes a type of slip which is inconsistent with experimental fact is surprising, since throughout our letter it was Dr. Goucher's own experimental results which were considered. It may be well, however, to review what assumptions were made. They were two, namely, that for a perfect wedge the atoms slipped on equidistant parallel planes and that the movement on these planes was equal. The only possible alternative to these assumptions would be that the slipping occurred on planes at different distances apart, but that then the extent of the displacement was in all cases proportional to the thickness of the slab of metal between one plane of slipping and the next. Such a supposition is so absurd as to carry its own refutation with it. Unless then all present ideas of the plastic deformation of metals are entirely inaccurate, and the displacement does not occur by slip, there is no alternative to the only two assumptions we have made.

Our analysis was concerned with one part of the wedge only, and there is no question of a difference in wedge angle between one half of the fractured test-piece and the other. Dr. Goucher emphasises what he had already found, namely that the wedges had an included angle of 39° or more than 50°. We are quite unable to see why he should imagine there is any difficulty in this, since not only have we considered the fact but have even offered a reasonable explanation of why it should be so. He complains further that we have not taken into consideration the fact that the larger wedge angles were found only with test-pieces whose {112} planes were slightly asymmetric with regard to the direction of the stress. The reply is clear. We have not been concerned with the explanation of the deformation of the crystal. All we attempted to do was to discover, when a certain deformation had been produced, what was the nature of the atomic displacement in the final wedge. That asymmetry of crystal is necessary for the production of a blunt wedge is merely an experimental fact which has no bearing on our analysis of the deformation when it had actually been effected.

We would point out again that our letter offered a reasonable explanation and, incidentally, the only comprehensive one yet suggested, of all the experimental results which Dr. Goucher has obtained in his most excellent experimental work. Until, therefore, something more satisfactory is offered it must take precedence over an explanation which, as a result as it seems to us of a perfectly arbitrary assumption, is capable of explaining half the results only, leaving the remainder as inexplicable anomalies.

May we in conclusion point out that in the formula in our original letter a misprint occurs, and that $2/\phi$ should be $\phi/2$?

W. E. W. MILLINGTON,
F. C. THOMPSON

Manchester, August 24.

The Ionisation Potential of O II.

PROF. A. FOWLER has worked out (*Proc. Roy. Soc.*, **110**, 476, 1926) with much elaboration the main spectral characteristics of O II, but has not been able to obtain the fundamental levels because the jumps to them produced lines which were below 700 Å.U. With our high resolution hot-spark spectroscopy for the extreme ultra-violet and assisted by the new methods of identification of multiplet structure recently worked out by Russell, Hund, Heisenberg, and Pauli, and applied by R. H. Fowler and D. R. Hartree (*Proc. Roy. Soc.*) to the classification of Fowler's O II terms, we have succeeded in accurately fixing these fundamental levels as is shown in the accompanying table. Russell assisted us in this search by placing at our disposal his unpublished identification of the quartet p'' level, which should replace the x_3 level in Fowler and Hartree's classification.

The knowledge of this ionisation potential of O II should be useful in fixing the temperatures of certain stars.

I. S. BOWEN.
R. A. MILLIKAN.
Norman Bridge Laboratory of Physics,
California Institute of Technology, Pasadena.

TABLE I.

Series Lines of O II.

Int.	λ I.A.Vac.	ν	Δν	
		Quartet System.		
1	429·97	232574·4		$as - p''$
3	539·067	185505·7	157·1	$as - ap_3$
2	539·524	185348·6	107·5	$as - ap_2$
1	539·837	185241·1		$as - ap_1$
		Doublet System.		
0	440·51	227010·		$x - bp''$
1	441·97	226260·		$x - cd'$
2	481·56	207658·		$x - bd'$
2	484·00	206612·		$x - ap''$
2	485·56	205948·		$x - f$
4	616·325	162252·	185·	$x - 2p_2$
4D	617·030	162067·		$x - 2p_1$

Term Values.

$x(p'$ or $d) = 256202·$

Assuming $ap_3 = 97100·$[1]

$as = 282605·9$

This corresponds to the ionisation potential 34·88 *volts.*

To the foregoing interesting communication, I think it may be usefully added that the designations and values of all but one of the doublet terms, apart from x, are those given in the paper by myself to which reference is made, namely:

$$\begin{cases} ap_2'' = 49590·80 \\ ap_1'' = 49476·81 \end{cases} \quad \begin{cases} bd_2' & 48618·42 \\ bd_3' & 48565·45 \end{cases} \quad \begin{cases} 2p_1 = 94132·52 \\ 2p_2 \ \ 93952·53 \end{cases}$$

$$\begin{cases} bp_1'' = 29231·39 \\ bp_2'' = 29229·03 \end{cases} \quad \begin{cases} cd_2' = 29974·67 \\ cd_3' = 29972·55 \end{cases}$$

The f term (= 50273·5) was afterwards provisionally identified as such by Fowler and Hartree from lines which I had somewhat doubtfully indicated as involving a term xd_2'. The writers of the letter appear to have overlooked the fact that Fowler and Hartree had already identified my x_3 term as the unresolved first p'' term of the quartet system.

While the value indicated for the as term is probably not much in error, it should be understood that the value of ap_3, on which it depends, remains somewhat uncertain. A Rydberg formula for ap_3 and bp_3 gives $ap_3 = 98850$, but this can only be regarded as an approximation, since only the first two terms of the sequence are known. A more trustworthy value would result if intercombinations between the doublet and quartet systems could be traced.

A. FOWLER.

[1] A. Fowler assumes $ap_3 = 100,000$. We have changed to the foregoing value in order to bring the Ritz formula for the sequence of ap and bp terms into better agreement with that for the corresponding terms of N I.

The Earliest Human Knowledge of Copper.

THE first discovery of metals by man is usually described as having resulted from the association of the necessary materials in the construction of a primitive hearth on some chance occasion. At best, this explanation does not contradict our accumulated knowledge about the habits and conditions of early human life.

There seems to me to be quite another possibility, not necessarily antagonistic to the earlier one, which is the outcome of a recent communication from Sir Flinders Petrie (*Ancient Egypt*, June 1926) on the Egyptian Paradise. He directs attention to the remarkable similarity of the place-names, the geography, and the " lakes of fire . . . in the midst of the paradise of cultivation " in the " Book of the Dead," with those of a definite region in the Caucasus —that along the rivers of the Iora and Kura. Then, following the normal lines of archæological argument, Sir Flinders suggests the possibility of the earliest Egyptian immigrants having come from that region.

It is known that some later arrivals, the earliest dynastic peoples, suddenly appeared in Egypt, equipped with a written language and with a knowledge of the working of metals, and of agriculture. If these constituted a later wave of wanderers from the same locality—just as there were several eruptions of tribes out of Arabia—they would bring with them knowledge naturally obtained from their home surroundings.

Copper occurs widespread throughout the Caucasian area. So also does petroleum ; and the very locality in which Sir Flinders Petrie locates two lakes of fire and " a place of purification, probably by fire " from indications in the " Book of the Dead," is to-day occupied by an area of considerable richness in petroleum.

At one spot in a recent map (" Handbuch der regionalen Geologie," vol. v. pt. 5, heft 25, " Kaukasus," by v. Stahl, 1923) copper and petroleum are shown as being to-day in close proximity. But there must be and must have been innumerable seepages of oil over the whole area, so that many other points of intimate contact between copper and petroleum must have existed since remote times.

This being so, when a petroleum spring or lake became ignited, as is known occasionally to have happened, there is the greatest likelihood of the adjacent copper being reduced by the high temperature of the reducing flame to the metal itself, to be discovered by man at some later date.

This suggestion is supported by the fact that copper was in use very early in the history of the country that is now known as Iraq ; this is also a petroliferous region, as is shown by the presence and use of bitumen from the earliest times.

It would be interesting to speculate on local results when other minerals were smelted in the same natural fashion, including the effect of the liberation of large quantities of arsenic or arsenic oxide over the surrounding country. PERCY E. SPIELMANN.

The Athenæum, August 19.

The Zoological Names *Simia*, *S. satyrus*, and *Pithecus* and their Possible Suppression.

UNDER the above heading in NATURE of July 10, p. 49, Dr. C. W. Stiles gives a summary of the argument in support of a proposition to re-open the case of *Simia* before the International Commission on Zoological Nomenclature. Although in agreement with most of the general principles enumerated in his summary, we dissent from the view that the names *Simia*, *S. satyrus*, and *Pithecus* are ambiguous and " so confused in zoological literature as to preclude hope of reasonable uniformity in their use in zoological, bacteriological, serological and public health work."

With regard to *Simia* for the orang, the name is supported by the many mammalogists who signed the list of " Nomina Conservanda " published in the *Proc. Zool. Soc.*, London, 1924, p. 345. It is consistently used by naturalists in general. To suppose that bacteriological and medical writers (at all events those on this side of the Atlantic) would accept and use such a completely unknown name as '*Pongo*' for the orang is to show ignorance of the mentality and prejudices of the very workers for whose benefit the argument is professedly framed. For such writers, past, present, or future, *Simia satyrus* is the name of the orang, free from all ambiguity whatsoever, and with that widely signed " Nomina Conservanda " list to support them they would certainly regard '*Pongo*' as 'Jazz'—and go their old way.

The fact that Dr. Elliot, in his bulky work on Primates, has used another name, would seem to have unduly influenced those who framed the argument outlined by Dr. Stiles ; but unfortunately that work is so full of errors that as a standard of nomenclature it is repudiated by systematists in general.

The same has to be said about *Pithecus*, which is the technically correct name of the langurs, but has been wrongly used in another sense—for the macaques by Dr. Elliot alone among mammalogists. This wrong use has received no acceptance whatever, and cannot be said to render the name *Pithecus* ambiguous or unsuitable for acceptance by medical and other writers.

We would therefore reiterate our opinion that *Simia satyrus* for the orang, and *Pithecus* for the langurs fulfil the demand for names which are " thoroughly unambiguous and suitable."

Moreover *Macaca*, for which, according to the letter of Dr. Stiles, *Pithecus* would be abolished as the name of the macaques, should be, and is, used for these very animals, side by side with *Pithecus* for the langurs.

Arguments in favour of *Simia* for the orang are to be found in the Fiat lists above referred to, and for *Pithecus* in a paper by Thomas in the *Ann. Mag. N. H.* (8) xvii. p. 179, 1916. OLDFIELD THOMAS.
MARTIN A. C. HINTON.

British Museum (Natural History),
Cromwell Road, London, S.W.

Lead Hydrogen Arsenate as a Mineral.

A SPECIMEN from the Tsumeb mines in the Otavi district, South-West Africa, recently acquired for the Mineral Collection of the British Museum, shows colourless transparent crystal plates with brilliant lustre, which had been labelled 'lanarkite.' The largest of these are 1 cm. across with a thickness of 1 mm. They rest on a crust of bayldonite pseudomorphous after mimetite (chloro-arsenate of lead), chessylite, and large crystals of anglesite ($PbSO_4$). The crystals are monoclinic ($a:b:c = 0{\cdot}8643:1:0{\cdot}7181$, $\beta = 84^\circ\ 36'$) and show a development of sixteen crystal-forms. These forms have been listed to show the angles from each to the three axial planes ; and it is believed that such a method of tabulation may effect a compromise between the method of giving interfacial angles in zones and that of longitude and latitude (ϕ and ρ) angles employed in two-circle goniometry. The crystals are optically positive, and the optic axial plane is perpendicular to the plane of symmetry and direction of good cleavage. The

refraction ($n_\gamma = 1 \cdot 9765$ for sodium-light), birefringence, and dispersion are all high.

A chemical analysis made by Mr. E. D. Mountain on a quarter of a gram of carefully selected crystal fragments agrees closely with the formula $PbHAsO_4$. It was then found that the crystallographic data agree with those previously determined for artificial crystals of this substance. A copy of E. S. Fedorov's "Tables for Crystallo-chemical Analysis" not being available, it was not possible to identify the substance from the crystallographic data alone. Artificial crystals of lead hydrogen arsenate had been prepared and completely determined crystallographically by the late Baron A. de Schulten (a political refugee from Finland, who worked in the chemical laboratories of the Sorbonne in Paris) in 1904. He also prepared a series of other compounds isomorphous with the mineral monetite ($CaHPO_4$), with strontium, barium, or lead in place of calcium, and arsenic in place of phosphorus. Of these only $CaHPO_4$ has been hitherto known to occur in nature. For the compound $PbHAsO_4$ occurring as natural monoclinic crystals the mineral name *schultenite* is suggested. The "lead arsenate" of commerce is the same substance. This is used as an insecticide, especially in America in sprays for fruit-trees; and being practically insoluble in water it is no doubt responsible for the retention of arsenic in apples.

A detailed account of the new mineral, so far as this can be completed from the single specimen, will be given in the December issue of the *Mineralogical Magazine*. There are no doubt other specimens of this mineral in collections amongst the rich series of crystallised material that has come from the Tsumeb mines. L. J. SPENCER.

British Museum (Natural History), South Kensington.

The Anomalous Flocculation of Clay.

IN a letter to NATURE of May 1, 1926, Dr. Joseph and Mr. Oakley allude to some experiments which have convinced them that the alleged anomalous flocculation of clay does not exist. The anomalous flocculation of clay is said by them to be the accelerating influence of hydroxyl ions on flocculation by calcium salts when compared with the retarding effect of hydroxyl ions on flocculation by sodium salts. I should like to submit, however, that the behaviour of calcium ions in alkaline medium is not regarded as anomalous by comparison with the behaviour of sodium ions in alkaline medium. Flocculation of clay by calcium salts is anomalous when considered in the light of prevalent theories, and not necessarily when compared with the behaviour of other ions. As I understand the anomalous flocculation of clay, the most that could be claimed by Dr. Joseph and Mr. Oakley is that the sodium flocculation of clay is also anomalous.

One realises, of course, that within the limits of a letter a description of experimental detail is not possible, but it is crucially important to know what precisely is meant by a "highly purified clay." The significance of the results in question is entirely dependent upon the complete removal of both adventitious and absorbed calcium in the clay. A highly purified clay suspension would ordinarily be taken to mean a suspension of clay in which there was no appreciable amount of the coarser particles, but such a clay suspension would still contain absorbed calcium, and on the addition of sodium salts that calcium would come into solution. Soils containing absorbed calcium can ordinarily be flocculated by the addition of a sufficient amount of alkali, but according to some incidental observations made on soil suspensions in these laboratories by S. J. Saint (*Proc. 2nd Comm. Intern. Soc. of Soil Science*), when the absorbed calcium has been completely replaced by sodium, no amount of sodium hydroxide will bring about a flocculating effect. N. M. COMBER.

The University, Leeds.

Persistent Solar Prominences.

IN NATURE for July 24, page 131, reference is made to a large prominence formation on the sun's north-western limb on July 16. Apart from the interest in this display as to grandeur, consideration is enhanced by the fact of the many repeated appearances of this particular display. My records, which cover 71 observing dates since June 1, show that the first appearance of this exceptional formation was on June 18, in the north-west quadrant, in the north-east quadrant on July 2 and 3, again in the north-west on July 16, in the north-east again on July 29 and 30, once more in the north-west on August 12, and, although reduced somewhat, once again in the north-east on August 25 and 26.

We have thus 2½ complete synodic revolutions of the sun, during which this formation was preserved practically to the full extent for two complete synodic rotations, the display being easily recognisable, not only by its large extent, but also by the particular form which the various constituents retained, mostly magnificent tree forms, with bright trunks spreading into an elaborate tracery of interlacing branches. On the last appearance the trunks only seemed to be left, although faint overhead festoons and filaments were still visible. ALBERT ALFRED BUSS.

Lee-Observatory, Chorlton-cum-Hardy, Manchester, August 27, 1926.

Spraying Crops from Aeroplanes.

IN NATURE for August 14, p. 239, it is recorded that the first attempt in Great Britain to utilise the aeroplane for spraying operations took place in Lincolnshire in August 1926. It is to correct an error that the present communication is made. The first record of powder spraying by aeroplane in Britain is made in the *Fruitgrower*, June 29, 1922, and of which no reference can be found in NATURE of that year.

The experiment took place at Portobello Farm, Kingsdown, near Sevenoaks, owned by Major R. F. Bartlett, on an eighteen-acre cherry orchard badly infested by caterpillars. The material used was a proprietary dust ('Belummite') manufactured and supplied by Messrs. W. J. Craven and Co., Evesham. The lessons learnt at this initial experiment are published in the *Fruitgrower*, July 13, 1922.

It should be placed on record that Major Bartlett was the first in Great Britain to use the aeroplane for the control of orchard pests, although the recorded facts of the efficiency of the method leave much to be desired. G. FOX WILSON.

Dept. of Entomology, R.H.S. Laboratory, Wisley, Surrey, August 27.

International Code of Zoological Nomenclature.

DURING this year I have so often been asked how this Code could be obtained that I hasten, with your permission, to announce that the Washington Biological Society has just published a reprint at the price of one dollar. Prof. C. W. Stiles, secretary to the Commission, says: "I would suggest that, if your colleagues wish copies, it would expedite matters to order a number at once." The address of the Society is at the Bureau of Entomology, Washington, D.C., U.S.A. F. A. BATHER.

46 Marryat Road, Wimbledon, London, S.W.19.

Seven Decades of Botany.[1]

By Prof. F. O. BOWER, F.R.S.

"The future of Biology lies not in generalisation but in closer and closer analysis."—BATESON (Birkbeck Lecture, 1924).

DEATH sudden and wholly unforeseen has stepped between Section K (Botany) and the president of its choice. Dr. Bateson had presided over the whole Association at its meeting in Australia, and partly on that account he had been specially selected for the chair of this Section in Oxford. From him we might have expected a broad outlook upon biological science. His address would have been instinct with wide experience in both of the branches of living things, the interests of which interweave in enthralling and often most perplexing ways. We should have heard a fearless statement of his mature views. Something constructive would certainly have justified the congratulations with which some of us had already welcomed his nomination. A great figure has been taken from the arena of biological science. A career still full of the promise of further achievement has closed prematurely.

This is not the time or the place for any comprehensive obituary of Bateson. I will only allude briefly to four leading events in his scientific career. He felt in early life the lack of facts bearing on variation, and sought to extend their area in his great work "Materials for the Study of Variation," published in 1894. This was the year when the British Association last met in Oxford. I do not remember that its contents came into the discussions in Section D, though the book centred upon the vital question of continuity and discontinuity. The second event was the publication in 1902 of "Mendel's Principles of Heredity," in which, though essentially a controversial statement, Bateson perceived latent in the rediscovered writings an expanding vista of advance. "Each conception of life," he says, "in which heredity bears a part must change before the coming rush of facts." In a third stage of his work Bateson expanded this theme into a fuller statement under the same title, and it was published in 1909. Passing from this period of high hopes to the fourth phase of 1924, we see in his address at the Birkbeck Centenary a chastened attitude. He there remarks: "We must frankly admit that modern discoveries have given little aid with the problem of adaptation," and that, much as Mendelian analysis has done, "it has not given us the origin of species." But that analysis having "led to the discovery of transferable characters, we now know upon what to concentrate. . . . Henceforth the study of evolution is in the hands of the cytologist acting in conjunction with the experimental breeder. Every appeal must ultimately be to the mechanics of cell-division. The cell is a vortex of chemical and molecular change. . . . The study of these vortices is biology, and the place at which we must look for our answer is cell-division." I would ask you to mark that last word. It is cell-division, not nuclear division; and earlier in his address we find the pregnant sentences: "As to what the rest of the cell is doing, apart from the chromosomes, we know little. Perhaps the true specific characters belong to the cytoplasm, but these are only idle speculations." Such extracts from Bateson's latest public pronouncement may suggest to you what the Section has lost by his death. They show the mind still elastic and perceptive: still both constructive and critical.

Any address that follows such a tragedy of disappointment as the Section has suffered can only fall short of what we had hoped to hear. Instead of attempting to fill the broad biological rôle that naturally fell to Bateson, I propose to centre my remarks upon three dates when the Association has met in Oxford, namely, 1860, 1894, and 1926. It happens that these dates mark approximately periods of transition in the progress of biological science, and particularly in botany.

1860.

I need scarcely recall that the meeting in Oxford of 1860, the year after the publication of the "Origin of Species," witnessed the clash between the new view and the opposition it was certain to arouse. The story has been often told of the aggressive attack and the crushing retort. But it is not sufficiently recognised that, though Huxley bore the first brunt of the fight, a large part in the contest was taken by Hooker. The meeting closed after he had spoken, and in his own words he was "congratulated and thanked by the blackest coats and the whitest stocks in Oxford."

Two generations have passed since the Oxford meeting of 1860: and still the "Origin of Species" holds its place as a great philosophical pronouncement. As the methods of research passed into greater detail, the area of fact has been extended through the labours of an ever-growing army of inquirers, and naturally divergences of view have arisen. Some authors appear to demand that for all time the "Origin" must cover every new aspect of biological inquiry, or else the whole theory crumbles. That is to demand a prophetic vision for its author. We need not for the moment follow these or other criticisms, but rather recognise that the theory rested essentially on facts of heritable variation, without defining their magnitude, limitations, or origin; and that it explained a means of their summation so as to produce progressive morphological results.

Before we leave the historical aspect of evolution a moral may be drawn from the lives of its four protagonists of 1860. Darwin, Wallace, Hooker, and Huxley were all equipped for the battle from the armoury of personal experience in the great world. The theory of evolution was born and bred of foreign travel, and upon foreign travel quite as much as upon quiet work at home its future still depends. We should not for a moment minimise the great developments of laboratory study and of breeding experiment in recent years that bear upon its progress. But it is not thence alone that the fullest achievement can be anticipated. The cytologist and the breeder, just as much as the abstract theorist, should know Nature

[1] From the presidential address to Section K (Botany) of the British Association, entitled "1860—1894—1926," delivered at Oxford on August 5.

face to face, not merely through a glass darkly. To those who believe in the close relation between environment and variation, which is to me the very core of evolution, this seems essential to any well-balanced view. The open forest, the sea-coast, steppe, and mountain-side should be regarded as the natural complement to the laboratory and the breeding-station. No one, morphologist or physiologist, should hold himself equipped for research or fully qualified to teach unless he have at least some experience of travel through wild Nature. This can best be acquired in the tropics.

What, however, do we find? In 1886 a committee of the British Association was appointed to assist the visits of botanists to Ceylon for study. Several well-known botanists availed themselves of its aid; but after a few years the scheme flickered out through inanition. In 1909 I visited the Cinchona Station in Jamaica, and again a scheme for continued use of the station by British botanists was initiated; but it has since died out for want of consistent support. Why did these efforts fail? We may set these failures down to under-valuation of the importance of foreign, and particularly of tropical, study; and the lack of full perception that open Nature is the greatest laboratory of all. Our future botany seems in danger of becoming myopic by reason of study being concentrated at too short focus. To correct this, young aspirants should travel early, as free lances, hazarding the fortune of the wild, as Darwin and his fellows did.

HOMOPLASY.

I have already alluded to the tempestuous meeting of 1860 in Oxford. Shortly after it an undergraduate came up to Christ Church who, before he was of standing to take his M.A. degree, had himself made a real contribution to the philosophy of evolution. It was Ray Lankester, who in 1870 published a short paper "On the Use of the term Homology in Modern Zoology, and the distinction between Homogenetic and Homoplastic Agreements." Its author was only twenty-three years of age, and its date barely a decade after the publication of the 'Origin.' This short paper went far to clear up the vague ideas surrounding the term 'homology' in the minds of early evolutionists. Lankester introduced the idea of 'homogeny,' substituting in a more strict sense the word 'homogen' for 'homologue.' He also suggested, to avoid confusion, the use of another new term, namely, 'homoplasy.' He defined homogeny as simply the inheritance of a common part, while homoplasy depends upon the common action of evoking causes or of a moulding environment upon homogonous parts, *or* upon parts which for other reasons offer a likeness of material to begin with.

This definition was at once adopted in the morphological study of animals, but Lankester did not himself apply it at the time to the morphology of plants. In point of fact the conception of homoplasy and the use of this clarifying term made its way but slowly into botanical literature. There is reason to believe that we are as yet only beginning to recognise in the evolution of the plastic plant-body how far-reaching has been the influence of homoplasy, not only upon external form, but also in the internal evolution of tissues. We are only now beginning to realise how far-reaching have been its results in plants as we see them. On the other hand, such realisation when well assured cannot fail to react upon our estimates of affinity of the organisms in which homoplasy appears. It may be going too far to trace all such results as consequences of the meeting of 1860; but the initiative was certainly given by Lankester in the years that followed.

1894.

Passing from the stormy period of 1860, when the whole outlook of biological science was being transformed by the advent of evolution, to 1894, we see that the atmosphere had cleared. One result was that the evidence of descent tended to become too definite in the minds of some enthusiasts, and there was even a disposition to argue deductively from the accepted position, a tendency that is much too prevalent to-day.

The outstanding feature of the Oxford meeting of 1894 was Strasburger's generalisation on the periodic reduction of chromosomes. This shed a new light on the vexed question of alternation, which, based on the brilliant results of Hofmeister, by this time held the field not only as an objective fact but also as an evolutionary problem. The effect of Strasburger's communication was to establish the chromosome-cycle as general for plants that show sexuality. It provoked comparison with a similar cycle in animals. The recognition of both cycles took its origin in the discovery by van Beneden in 1883 that in sexual fusion the number of chromosomes is the same in both of the conjugating nuclei. Later observers have confirmed this in a multitude of instances, and disclosed the correlative reduction, or meiosis. The existence of a nuclear cycle alike in animals and in plants cannot, however, be held as establishing any homogenetic unity of the two kingdoms. Comparison of the simpler forms of each indicates that the divergence of the kingdoms, if they ever had a common origin, was very early indeed, and probably antedated sexuality in either. Such similarities as they show in propagative detail, and particularly in the nuclear cycle, would be homoplastic, not homogenetic. If this be so for the two kingdoms of living things, may it not be equally true for the several phyla of plants that show sexuality; for we are not justified in assuming that sexuality arose but once in plants?

Historically this generalisation of Strasburger fell like a bomb-shell into the midst of the old controversy between the rival theories of alternation, styled in the words of Celakovsky 'homologous' and 'antithetic.' But it must be remembered that at the moment there was no complete demonstration of a cytological alternation in any one Alga, though the facts soon followed for Fucus and for Dictyota. We need not recite again the arguments for and against that old discussion. It soon lost its intensity in face of the obvious deficiency of crucial facts, which alone could lead to some final conclusion. Loose comparisons between organisms not closely allied are but the long-range artillery of morphology. Comparisons between organisms closely related are its small arms. The discussions of the 'nineties of last century on alternation were all engagements at long range, which could not be decisive

without the use of close comparison. As the necessary facts were not then in our hands, those premature engagements might be held as drawn; and it was open to both parties still to entertain their own opinions.

Before discussing the relation of somatic development to that cycle, it will be well to revise the terminology then in use. It would be well to drop those old terms, which are neither exact nor explicit, and to support a more general use of the words 'interpolation theory' in place of 'antithetic' and 'transformation theory' in place of 'homologous.' These words accord better with current views, and are explicit.

1926

From the time that the periodic reduction of chromosomes was recognised as general in organisms showing sexuality, the nuclear cycle has formed a natural foundation for the comparison of the life-histories of plants. The normal cycle may be figured to the mind as a closed circular thread with two knots upon it, syngamy and reduction. Between those knots beads may be strung, one or more than one, or none. These represent somatic developments, which are normally diploid between syngamy and reduction, haploid between reduction and a fresh act of syngamy. They follow in alternate succession in any normal cycle, but either may be repeated indefinitely by vegetative propagation.

Certain questions arise with regard to the evolution of these somata as we see them. The first is, how far are the diploid and haploid somata of the same cycle comparable one with another? The reply will turn upon the constancy of the events of syngamy and reduction throughout descent. If they were constant, then it appears a necessary consequence that the alternating diploid and haploid somata must have been distinct throughout their history; and any similarity which they may show, as in Dictyota or Polysiphonia, would be homoplastic. It would indeed appear natural that they should be alike in Algæ, since they are parts of the same organic life and live in identical circumstances. It has, however, been suggested that reduction may not be a fixed but a movable event in the individual life: liable to be deferred or carried over to a later phase, in which case a diploid generation might arise by transformation from an already existent haploid phase. The monospores of the Nemalionales have been cited as possibly convertible in other red seaweeds into tetraspores, by some sudden deferring of the act of reduction.

I am not aware that this has been advanced by close comparison beyond the position of tentative suggestion, though the existence of a diploid gametophyte and of a haploid sporophyte in certain abnormal ferns would indicate the possibility of the suggestion being true. Pending the advance of a closely reasoned argument it is best to keep an open mind. Meanwhile the weight of facts hitherto known from plants at large may be held to support the stability of the events of syngamy and reduction during normal descent. The two generations of the same life-cycle would, in the absence of a carry-over of reduction, be homoplastic, not homogenetic.

No one has yet made out a closely reasoned case for the descent of the Archegoniatæ from the green, the brown, or the red algæ. The old view that they originated from the green algæ has never recovered from the blow delivered by Dr. Allen, when he showed that the reduction in Coleochæte takes place in the first divisions of the zygote, and that the presumed primitive sporophyte is really haploid, and not cytologically a sporophyte at all. It is a perfectly tenable position to hold that the Archegoniatæ sprang directly from none of these groups, as we know them. In the absence of definite comparative evidence, the field appears to be open to an origin of alternation in the Archegoniatæ by interpolation of a sporophyte *de novo*, developed not in water but in relation to a land-habit.

DEVONIAN FOSSILS AND A LAND FLORA.

Palæobotanical discovery has been greatly advanced within the period under review. The features of the vegetation of Mesozoic time are becoming clearer than ever before under the hands of Prof. Seward. The Carboniferous flora has been richly presented to us by Williamson, Scott, Oliver, and Kidston in Britain, and by continental workers such as Renault, Zeiller, Bertrand, Nathorst, and Solms-Laubach. We are now able to substitute something positive in place of vague surmisings. Not only do the new facts illuminate our knowledge of plants now living, but they also apply a check upon theories as to their origin.

Latterly a vision is becoming ever more and more real of a Devonian flora, revealed by Kidston and Lang in Britain, and by other workers in Scandinavia, in Germany, and in America. Given more extended collecting, an improving technique, and the fortune of finding more material as well preserved as that at Rhynie, who knows but what the coming decades may see the land of the Devonian period clothed before our eyes by a flora no less stimulating and even more suggestive than that of the coal? But though Devonian lands are the earliest yet known to have supported a sub-aerial flora, the highly advanced structure of such a fossil as *Palæopitys Milleri* suggests that we are still far from visualising the actual beginnings of land vegetation. Moreover, the mixture in the Rhynie Chert of algal types with vascular land-plants presents at the moment a problem as perplexing as it is ecologically strange.

It is always difficult to estimate justly the times in which we live; but we may well believe that the future historian of botany will note the present period as one specially marked by successful study of the floras of past ages, and by the increasing cogency of their comparison with the vegetation of the present day.

THE *ANNALS OF BOTANY* AS AN HISTORICAL DOCUMENT.

Perhaps too much time has been claimed for morphological questions, which are closely related to the dates of the three meetings of the British Association in Oxford. The brief space that remains may be devoted to a more general survey of the period which these dates cover. In this we could not do better than to take as an index the pages of the *Annals of Botany*, for the existence of which we owe a deep debt to the Oxford Press. In 1860 there was no organised laboratory

teaching of botany in any university in Britain; and as yet there was no journal of the nature of the *Annals*. But the revival of close observational study in botany under Huxley and Thiselton-Dyer at South Kensington in the early 'seventies, recorded last year by various writers in the *New Phytologist*, was beginning to take effect in 1881, when the British Association met in York. There the outstanding feature was the address of Hooker on geographical distribution. This and the papers by Bayley Balfour on Socotra and by Baker on Madagascar were all that really mattered botanically, and almost all the contributions were systematic or regional in subject. The revival of the laboratories had not yet fructified.

At this time all the work that was done in laboratories was called 'physiology,' as distinct from systematic botany, which was conducted on dry specimens in the herbarium. In 1887, six years after the York meeting, the *Annals of Botany* was founded through the activity of the late Sir Isaac Bayley Balfour, and a small committee of guarantors whose personal security induced the Clarendon Press to make the venture. From the start that journal has paid its way. The forty stately volumes form a record, between the pages of which may be read the history of botanical progress in Britain, and in some degree also in the United States, for American botanists have always been with us in its pages.

In the first issues of the *Annals*, morphology and systematic botany preponderated, and from the proceedings of the meeting of the British Association in Oxford in 1894 we see that this was still so. That meeting witnessed a crisis in the affairs of botany in Britain. A newly established Section I of Physiology assumed that the functional activities of plants would be swept, together with those of animals, into its hands. Up to this time Section D had been the undivided section of Biology. An irregular cleavage of interests was set up by this claim, for the zoologists were mostly willing to give up their physiology, but the botanists were not. Their refusal to accept divorce of form from function contributed to, or at least coincided with, the foundation of a separate Section K of Botany, and has dictated the policy of British botany ever since.

As we pass from 1894 to the current period we perceive a marked shifting of the interest of botanists from the study of form to that of the intimate constitution and functional activity of plants. Whole fields of colloidal chemistry and physics, of quantitative physiology, of cytology and genetics, of ecology, of fungology and bacteriology, have been opened up. The present century has been specially marked by the extension of opportunities for physiological research, by better equipment of departments in the universities, and by the foundation of independent establishments carrying on experimental inquiry in its broadest application. This is rapidly bringing the science into closer relation with Imperial and social aims.

It is needless to specify, but the effect of it all is plainly written in the pages of the *Annals*. Experimental results have gradually taken the preponderant place over description and comparison, as is amply shown in the last January number. 'For better, for worse,' the pendulum has definitely swung over from the extreme systematic position of half a century ago, through a phase of prevalent morphology (or perhaps we should better say of organography), to an extreme physiological position at the present time. Some may even have felt that this address is in itself an anachronism, in that it has not touched upon the moving physiological questions of the day. While I may claim none the less to sympathise with physiological aspirations, I do not assent to any ultra-physiological aspect of botany that would degrade or minimise the comparative study of form. *Medio tutissimus ibis* is still a true maxim. The laboratory physiologist, dealing with the things of the moment, cannot safely detach himself from the things of the past as recorded in heritable form. He should not allow himself to be immersed in statistics and neglect history. The pendulum has gone full swing, within a period of about half a century; but we may confidently anticipate a return towards some middle position.

Power Alcohol and other Petrol Substitutes.

ALTHOUGH opinions differ concerning the extent of the world's petroleum reserves, it is generally agreed that if the consumption of petrol continues to increase at its present rate, available supplies will soon become inadequate. Thirty years ago, it is said, there were but four motor cars in the United States; to-day there are nearly twenty million, and the consumption of petrol in that country has risen to about 900 million gallons a month. The demand for aviation shows every sign of expanding, and when we consider that petroleum is very unequally distributed in the earth's crust, and that economic independence is still a watchword in international politics, we can readily understand the vigorous efforts that are being made to produce liquid fuels by artificial means.

So far as we can see to-day, there are not many possible alternatives to petrol. There are, indeed, immense supplies of liquid fuel lying dormant in the oil-shales that are so abundantly distributed over the earth, but until methods of extraction and purification are devised that are both technically and economically successful, we shall continue to look to other fossil fuel, coal or peat, to vegetable matter, and to the mixture of carbon monoxide and hydrogen known as 'water-gas,' to supplement our present supplies of petrol, and to replace them when the day of extinction draws nigh.

Benzol is an excellent motor-fuel, but its production is comparatively small; and it is required for other purposes: for example, for dyes and explosives. Acetone is the ideal liquid for mixing with other motor-fuels, but at present it is too costly to compete with them, although its commercial production through the acetic acid made by fermenting cellulose may be achieved at an early date, and so bring it into the foreground. Alcohol is of especial significance, because the raw materials of its manufacture, cellulose and sugar, are renewed incessantly by a bountiful Nature, and also because its value as a motor-fuel, particularly in admixture, has been proved beyond a doubt. Hydrocarbon

oils of low boiling-point, such as are produced by 'hydrogenating' coal and peat, or by passing water-gas over heated catalysts, are among the most likely substitutes for petrol; from the technical standpoint the elaboration of such processes will be comparatively easy; the whole issue lies in their economy. Though the raw materials—coal, peat, air, water—are cheap, heavy capital expenditure upon plant appears to be unavoidable, and in some instances a considerable amount of energy has to be expended in promoting the chemical reactions concerned.

Of a different order are the processes for producing alcohols (and acetic acid) from cellulose or sugar by fermentation, for they require neither a high temperature nor a high pressure. Here again the problem is essentially an economic one. The raw material may be very cheap, especially if it grows wild, but it may cost a great deal to collect and transport. A few years ago there was much talk of utilising the Indian mahua flower as a source of power alcohol, but the proposition was soon found to be uneconomic, mainly on account of the cost of collecting the flowers. Cultivated sugar-cane and sugar-beet are necessarily more costly than wild vegetation, and they cannot be grown everywhere. Moreover, they contain an essential foodstuff, and the world-price of sugar rules them out as sources of power alcohol unless their production is subsidised by the State. Molasses, being a by-product, is in a different category. Although it is produced in considerable quantity (constituting about 30 per cent. of the weight of raw sugar manufactured), supplies of it would not cover more than a fraction of the world's requirement of light motor-fuel in the event of a petrol famine; its production is confined to sugar-growing countries, and it is in great demand by manufacturers of rum and cattle-cake. The production of fuel-alcohol from molasses is now being undertaken on a large scale in Queensland, Australia, states Dr. W. R. Ormandy (*Journ. Soc. Chem. Ind.*, Aug. 13, 1926), where, with the aid of the Queensland Government, a plant is being erected to produce two million gallons of alcohol per annum, and three additional plants are projected. This enterprise will be assisted by the existence of a thriving sugar industry, and by the total absence of petroleum deposits in Australia.

Among post-War developments the initiation of a State-subsidised beet-sugar industry in Great Britain is one of the most interesting. A flourishing industry of this kind would have far-reaching effects, especially upon agriculture; and the view being held in certain quarters that agriculture would benefit more if beets were grown for the distillery than for the beet-sugar factory, the Government appointed a small committee, consisting of two chemists and one physicist, to inquire into certain economic aspects of the question. The report,[1] which was issued in July, is a short document of a few thousand words. In reply to the questions put to it, the Committee estimates the cost of raw material per gallon of alcohol (taken throughout as 95 per cent. by volume) to be 5 per cent. of the price per ton of beet, due allowance being made for the value of residual products. Cost of conversion or manufacturing cost is given as 9*d*. per gallon of alcohol, so that, excluding other charges (*v.i.*), the cost per gallon net naked at works would be 1*s*. 9*d*. or 2*s*. 9*d*., according as the price of sugar-beet is taken at 1*l*. or 2*l*. per ton. The yield of alcohol from one cwt. of sucrose is 8 gallons theoretically, 6·8 gallons in practice. With the aid of these figures, and taking 28*s*. per cwt. as the commercial price of sugar and 1*s*. 6*d*. or 2*s*. per gallon as the probable price of power alcohol, the Committee calculates that with the same rate of subsidy in both cases (19*s*. 6*d*. per cwt. for sugar and 2*s*. 10½*d*. per gallon for alcohol), the subsidy would amount to 70 per cent. of the commercial price of sugar, and 191 or 144 per cent. of the commercial price of alcohol.

The economic case against subsidising the sugar-beet industry for producing power alcohol is really stronger than these figures suggest. The Committee ignores (wittingly) charges for denaturing, packing, transporting, and selling. Assuming a wide distribution, these charges would amount to about 1*s*. per gallon; hence the subsidy would really represent 258 or 221 per cent. of the commercial price of the alcohol. Furthermore, it must not be overlooked that the present rate of subsidy is very high and will diminish as time goes on. Last season the price paid to English growers was about 56*s*. per ton of beet, and the subsidy per ton was about equal to the price received by Dutch growers for their produce; in other words, the English beet-sugar manufacturers practically obtained their raw material for nothing.

The Committee was also asked to report upon the prospects of producing power-alcohol by synthetic processes. Its reply is to the effect that the present position of such processes is obscure, and that reliable statements of costs will not be available for some time. Nevertheless, a useful appendix is inserted containing remarks on the chief processes that are potentially important for making alcohol and other liquid fuels from sugar, cellulose, coal, and water-gas.

Preparation through ethylene appears unlikely to provide alcohol in quantity, and synthesis from calcium carbide is regarded as improbable in view of the abandonment of carbide manufacture in this country owing to economic considerations. The use of water-gas for making liquid fuels, whether alcohols or hydrocarbons, is held to be promising, although but little has been done in this direction in Great Britain. Processes involving the use of high pressures, like those of Patart and Fischer, are referred to, but no specific mention is made of Fischer's work on producing hydrocarbon liquid fuel from water-gas without employing high pressures. In some quarters this development is regarded as a great advance, but it should not be overlooked that the saving effected by dispensing with the costly high-pressure plant is quite counterbalanced by the cost of the very much larger plant required for working with gases at ordinary pressure. A few reasons are given for and against the use of methyl-alcohol as a motor-fuel, but the Committee issues no verdict on this head. Actually methyl-alcohol is a very inferior fuel, not only because it has a low calorific power, but because it causes serious 'pinking' in the engine. The Committee thinks well of the possibilities of the improved Classen and Prodor processes for converting the cellulose of wood, or waste-wood, into

[1] Power Alcohol Production, being a report to the Minister of Agriculture and Fisheries of the Departmental Committee appointed by him in connexion with the Manufacture of Alcohol for Power Purposes from Sugar Beet. (London: H.M. Stationery Office, 1926.) 6*d*. net.

sugar and alcohol, especially in countries where wood is abundant. There is, however, little prospect for making alcohol from waste sulphite-liquors in Great Britain, whilst production by fermenting cellulose is more likely to be developed in the overseas dominions than in our own country.

The outlook for producing motor-fuel from coal is considered to be favourable, but not by the low-temperature carbonisation process, which, the Committee states, cannot yet be worked on a large scale at a profit, and when it can be so worked it would not provide more than a fraction of our requirements in heavy and light fuel-oil. The Bergius process (for the investigation of which the Government has recently granted the sum of 25,000*l.*) is stated to be the only one which could satisfy our requirements, but in view of the difficulty in constructing plant, some years must elapse before really commercial data concerning it can become available. In its remarks upon this process the Committee gives some quantitative data which are not up-to-date. The statement that at least one ton of coal must be burnt for every ton put through the process should read "one ton of coal is burnt as fuel for every *two* tons put through the process"; and the yield of light fuel is not 15 gallons but from 20 to 25 gallons per ton, according to the quality of the coal treated. Further, the remark that "65 per cent. of the weight of the coal may be converted into a kind of oil," would be more accurate in the form: "85-93 per cent. of the coal substance is converted into oil."

In its summary of this interesting section of the report, the Committee states that of all the processes not involving the distillation of fermented foodstuffs, the most likely to be adopted in Great Britain are those based upon the use of water-gas as raw material, and those by which fermentable sugars are obtained in high yield from wood. It is, however, strongly open to doubt whether the latter processes could be worked economically in Britain, where wood is scarce and expensive, and where wood-waste can only be collected and transported at prohibitive cost.

Discoveries in the Gobi Desert by the American Museum Expeditions.[1]

By Prof. HENRY FAIRFIELD OSBORN, For. Mem. R.S.

IN 1799, William Smith, then a young man of thirty, who was born at Churchill in Oxfordshire, dictated his now classic document, "The Order of the Strata," including a map showing the successive and characteristic fossils of southern Britain and the Oxford clay underlying this great University, with its Jurassic deinosaur Cetiosaurus. In the century and a quarter which has intervened before the present meeting of the British Association in Oxford, the twin sciences of geology and palæontology have reached a degree of precision which enables us, after our relatively brief and intensive surveys of the past four years, to declare 'the order of the strata' of Mongolia. Included in the Gobi Desert is a stratum equivalent in age to the Oxford clay of William Smith, containing the giant sauropod Asiatosaurus, a first cousin of the Oxford Cetiosaurus.

Meanwhile, physicists have extended the life-history period of the earth from the momentary 5000 years of Usher to the 1,000,000,000 years of Rutherford. This allows a comfortable margin of 400,000,000 years' time for the wonderful procession of evolutionary advance recorded in the twenty-four chapters of Mongolian prehistory, beginning with the equivalent of the Purbeck and Oxford formations of Upper Jurassic time, continuing with the appearance of man in the Old Stone Age, ending practically with the dominance of Ghenghis Khan, and followed by the decline of Mongolia to its present desert and relatively uninhabited state.

In the meantime, this now arid 'roof of the world' has been the scene of a whole succession of animal dynasties, fertile, productive, with a relatively temperate and invigorating climate, sometimes arid, sometimes pluvial, from first to last the homeland of waves of migrating land reptiles and mammals, which successively spread into every other continent (Fig. 1). It is a singular fact that this first and greatest of all life-centres (7) of prehistory was the last to be discovered, following by a half to three-quarters of a century the discoveries of great life-centres in Australia, in North and South America, in northern Africa, and in southern Asia. Although each of these great centres contributed its quota to the prehistory of the earth, none played a part at all comparable to that of central Asia.

With this introduction we may proceed to show by means of photography the contrast between the present geography of Mongolia and its palæogeography as recently revealed, and exhibit a new palæogeographic map of the world (Fig. 1) prepared especially for this discourse, showing that by placing North America on the east, Asia in the centre, and Europe on the west of an equal-area projection, we have a complete solution of all the animal migratory routes from Upper Jurassic time to the six great waves of human migration which swept over northern Asia into North America in late Pleistocene time.

PRESENT GEOGRAPHY OF MONGOLIA.

The position of Mongolia in Asia as shown in the map of Perthes may be projected areally on a map of the United States along lines of the 40th parallel; and there at once appears the remarkable similarity between the Mongolian fauna and that of the Rocky Mountain region throughout the entire period from Jurassic to recent times, the parallelism varying in closeness from epoch to epoch, at times Europe being closer than the United States. To the north of the hypothetical 'Gobia' lies 'Angara,' to the south the 'Gondwana' of Suess.

[1] From an evening discourse delivered to the British Association at Oxford on August 9. For further information regarding these expeditions reference should be made to "Methods and Results of the American Museum Expeditions in the Gobi Desert, 1922-25" (NATURE, August 7, 1926, pp. 198, 199), a lecture delivered to the Geological Society of London, June 23, 1926.

PERSONNEL AND TRANSPORTATION.

It has been estimated in the United States Geological Survey that as much was accomplished in three years by the American Museum survey as had been accomplished in the first fifty years of discovery in the corresponding Rocky Mountain region, namely, from 1850 until 1900. This was due to prolonged palæontological experience in America and to the combination of slow camel transport and rapid automobile transport, under the guidance of ten Mongols, ten Chinese, and an equal number of Americans trained in the western desert region. These rapid modern methods were rendered possible by the approval of the Mongol Government, but neither aeroplanes nor radio were allowed admission. Over the great level stretches now traversed by wild asses and gazelles, the camels advanced fifteen miles a day, the automobiles a hundred and fifty miles a day, or ten times as rapidly.

The routes and discoveries of three seasons (1922–1925) may be summarised as follows:

(a) Peking, Kalgan, Pang Kiang, Irden Manha, Houldjin, Iren Dabasu, Tuerin, Urga (the main and only telegraph line in Mongolia).

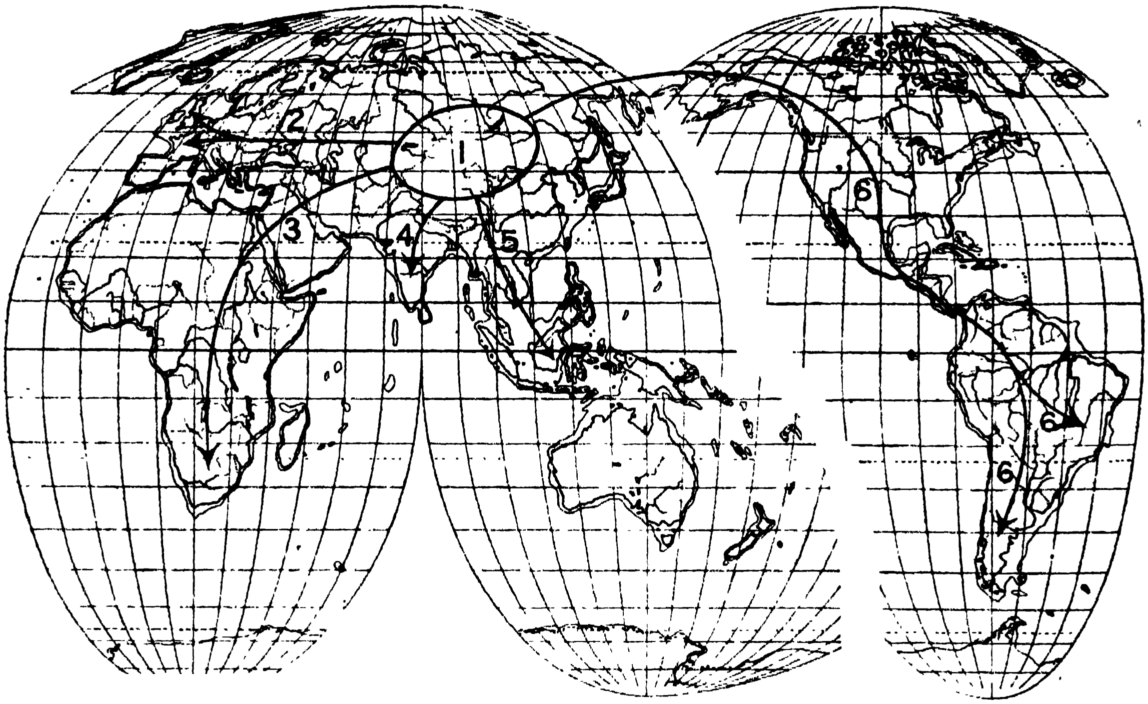
(b) North-west Uliassutai route: Shara Murun, Ardyn Obo, Sair Usu.

(c) Altai route, travelling southward to Kolobolchi, Ondai Sair, Oshih (Ashile), Djadokhta, Gashato, Golobol'n Ola.

(d) Northward on the main route to Urga through Irden Manha, Houldjin, to Iren Dabasu.

Excepting Peking and Kalgan, all these localities yielded fossils, often in enormous quantities. At Houldjin we found the very spot where Obruchev discovered the single rhinoceros tooth, hitherto the only fossil vertebrate found in all Mongolia. At Iren Dabasu Andrews pointed out to me distant fossil beds of the Wealden age on the horizon, a rich Lower Cretaceous level. Each of the watering stations mentioned in the above routes, where wells are sunk for the camels, now gives its name to a more or less great geological horizon or formation contemporaneous with the great horizons of western Europe or of the United States.

Nothing could exceed the fidelity and ability of the Mongols and of the Chinese; the former were found to be true to their word on every occasion, and the latter were not only faithful but also became extremely expert in the discovery of fossils; and many of them are now engaged in working the fossils out of the rock in our Peking laboratory.



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New Central Asiatic continent 26: Migration lines of the great reptilian Sauropoda—to Europe (2), to South Africa (3), to India (4), to Malaysia (5), to North and South America (6).

THE UPPER JURASSIC CONTINENT AND FIVE LIFE-ZONES OF UPPER MESOZOIC TIME.

It is an interesting coincidence at the present meeting of the British Association that the oldest horizons, known as Ondai Sair and Oshih (Ashile), are of sub-Wealden age and at present appear to be close to the Purbeckian and Oxfordian horizons of England. They contain primitive short-headed iguanodonts. Above them lies the Iren Dabasu, probably of Wealden age, containing large iguanodonts, ostrich deinosaurs, and megalosaurs. Still more recent are the famous Flaming Cliffs of the Djadokhta, which have no terrestrial equivalent in England; here were found the skulls of five small Cretaceous mammals and a host of deinosaurs, herbivorous and carnivorous, including the

now famous Protoceratops with its supposed enemy, the Oviraptor or egg-snatching deinosaur. From the lower Ashile level the giant sauropods, Asiatosaurus, may have wandered to all the great continents except Australia. The fascination and the perils of fossil hunting among the Flaming Cliffs of Djadokhta for the eggs and skeletons of deinosaurs were recorded by instantaneous photography.

Successive Life Phases of the Age of Mammals.

Even closer and more continuous is the remarkable succession of Gobi formations starting with the basal Eocene Gashato, of the same age as the Thanet sands of England and rising through beds of the age of the London clay to the Hordwell and Headon of the Isle of Wight, where England's terrestrial formations are interrupted, presenting a series of extraordinarily close parallels with the great Rocky Mountain succession from basal Eocene to Miocene time. In the creodonts, uintatheres, and titanotheres of the Gobi region we discover close generic and almost specific affinities to their distant American cousins. But the giant Baluchitherium, which had ancestors in Upper Eocene time and attained its gigantic size in Upper Oligocene time, seems to have had a monopoly of the central and south Asiatic region, because it has never been found elsewhere. In the Miocene and Pliocene phases of the Gobi there are some breaks which will doubtless be filled by future discovery, but in the Middle Miocene, and again in the Upper Pliocene, we discover close kinship to Western Europe and North Africa, especially in the arrival of the proboscideans or mastodonts of remote African ancestry. Thus the high plateau region of central Asia, including, doubtless, Chinese Turkestan, Tibet, and Mongolia, is firmly established as the previously missing area of origin not only of the terrestrial life of the entire northern hemisphere, but also of life which wandered into the extremities of Africa and of South America as well.

Scientific truth is far stranger than scientific fiction: Gobia takes the place of the mythical Atlantis and other imagined continents as the source of most of the animal civilisations and probably also of most of the vegetal civilisations of the northern hemisphere.

Discovery of the Old Stone Age in 1925.

At least four periods in the Old Stone Age of man were recognised in the campaign of 1925, namely, in descending order, Azilian-Campignian, (?) Mousterian, Acheulean (much more doubtful), and (?) Eolithic. Directly opposite the Flaming Cliffs of Djadokhta was discovered a great human culture level believed to be of late Palæolithic, Campignian, and Azilian age, with thousands of implements, to the north-east of the Mousterian horizon discovered by Licent at Ordos in north China. Above this closing Old Stone Age level occurred, in order, traces of Neolithic, of Bronze, and of Iron ages, ending in traces of pre-Mongol peoples which are succeeded by burial-places of the Mongol race that ended with the warrior race of Ghenghis Khan and the conquest of all southern Asia by Kubla Khan.

Thus are written twenty-four new chapters in the prehistory of the earth by the expansion and elaboration of methods of research first introduced to the world of science by William Smith of Oxford in his chart showing the companionship of geology and palæontology, and in the most unexpected manner connecting Mongolia with England and, especially, with Oxfordshire.

Observations with the Spectrohelioscope.

By Dr. George E. Hale, For. Mem. R.S.

The spectrohelioscope described in my article on "Some New Possibilities in Solar Research" (Nature, July 3, 1926) has been provided with new oscillating slits and driving mechanism and an improved parallel-plate line shifter and micrometer for setting various parts of the $H\alpha$ line on the second slit during observations, with divided arc indicating the exact wave-length employed. In this form the spectrohelioscope not only discloses the most delicate details of structure shown on the best Mount Wilson spectroheliograms, but has also served for the detection and measurement of some new and interesting phenomena.

Three cases observed on August 15 may be mentioned, all in the hydrogen vortices associated with the large spot group which on that day was near the central meridian of the sun. The first two were noticed south of the following spot of the pair. By rocking the parallel glass plate back and forth, thus showing the change in form with wave-length of two slender curved flocculi, their dark heads were seen to advance toward the spot as the $H\alpha$ line was moved across the second slit from its centre toward the red. At a slit position about 1·3 angstroms from the centre of the line, the curved flocculi had disappeared, but their point-like extremities were still visible, projected against the outer boundary line of the penumbra. If we assume this effect to be caused by the rapid descent of the hydrogen in the vortex above the spot, the radial velocity was about 65 km. per second. Another slender flocculus south of the preceding spot behaved in the same way. A similar observation on August 16 gave a maximum radial velocity of 56 km. per second for the descending point. These velocities are of the same order as those of knots in prominences moving toward spots, measured by Slocum and Pettit on photographs of the sun's limb made with the Rumford spectroheliograph, and observed visually by myself with the spectrohelioscope.

Although I confirmed the new results on August 17, the day I left Pasadena for a month's absence, I wish to check them more completely before expressing a final opinion as to their interpretation. It now seems probable, however, that the spectrohelioscope can be used for a more complete analysis than has previously been possible of the hydrogen vortices surrounding sunspots. These vortices involve the prominences as well as the chromosphere, and a means of measuring the velocities of the hydrogen, seen in projection against

the disc as well as in cross-section at the limb, should prove of great service.

If we may interpret another group of observations in the same way, the parallel plate micrometer will also make it easy to distinguish eruptive jets, rising near spots and descending at some distance after following a long-arched trajectory, from the true vortex structure with which they are likely to be confused on spectroheliograms. At their source these apparent jets often appear as bright flocculi, seen on the violet side of Hα, which seem to become dark absorbing streams at a higher level and finally descend at a velocity sufficient to produce a marked displacement to the red, beyond the normal boundary of the Hα line.

Bright hydrogen flocculi include those of the quiescent or slowly changing type and those of short life, which change rapidly in form and intensity. These short-lived bright flocculi are themselves of two kinds: eruptions, shown by the spectrohelioscope, when near the centre of the sun, to give a displacement of the bright Hα line to the violet; and bright flocculi which are receding or stationary in the line of sight. From my recent visual observations, it appears probable that the short-lived stationary or receding bright flocculi are often due to the descent of comparatively cool hydrogen, which appears dark at high levels but turns bright as it falls. The distinction is important, as terrestrial magnetic storms and auroras will probably be found to result from the presence near the middle of the sun of bright flocculi of the eruptive type, which emit charged particles at velocities sufficient to carry them to the earth.

Spectrohelioscopes capable of distinguishing such eruptions, if they could be built at small cost and used systematically at a sufficient number of stations well distributed in longitude, should aid materially in determining the exact relationship between these solar and terrestrial phenomena. After considering several possible designs, and making a variety of preliminary tests, I am now building a solar telescope and spectrohelioscope which promise to be both inexpensive and powerful. From tests already completed, I find that a single plano-convex lens of 3 inches aperture and 18 feet focal length, used with a simple heliostat or cœlostat just large enough to fill it with light, will serve very well for the necessary solar telescope. In the spectrohelioscope a single prism, twice traversed by the sunlight, will take the place of a grating. Its dispersion will be adequate with a focal length of 13 feet, or by the use of additional prisms the focal length can be reduced. For general use, fixed monochromatic telescopes of the above type will be less expensive and probably more satisfactory than those carried by an equatorial mounting. Moreover, I have designed a spectrohelioscope for attachment to equatorial telescopes, but have not yet found opportunity to build and test it.

Continued use of the spectrohelioscope has strengthened my hope that in the hands of amateur astronomers it may contribute materially to our knowledge of the solar atmosphere. As another indication of its service, I may add that on June 26 last I observed a phenomenon recorded but once, and then incompletely, in the entire collection of Hα spectroheliograms obtained on Mount Wilson since the beginning of such records in 1908. This unique case was the sudden engulfment, on June 3, 1908, of a large dark flocculus (prominence) by the vortex associated with a sunspot, illustrated and described in "Solar Vortices," *Astrophysical Journal*, vol. 27, September 1908. The phenomenon of June 26 was very similar in appearance, and although the parallel plate micrometer was not then completed, I was able to see its final stage, which was necessarily missed in the earlier record. This was the appearance of a black dot, after the large dark flocculus had been sucked into the vortex, exactly upon the outer (preceding) boundary line of the penumbra, as in the observations of August 15 and 16. This could be seen only when the second slit was on the red side of Hα, indicating the rapid recession of the hydrogen. The detailed observations will be given later. The point to be made here is that many interesting and unfamiliar phenomena of the solar atmosphere, including cases of this kind, can be observed by any one who cares to equip himself with the simple and inexpensive apparatus required. A full description of the instruments now under construction will be published soon after the final tests have been completed.

News and Views.

THERE have just been placed on exhibition in the Geological Department of the British Museum (Natural History) the remains of a Stegosaur or armoured deinosaur, obtained by the late W. E. Cutler from the Belly River sandstone of the Red Deer River, Alberta. Baron Nopcsa, who will soon publish a description of the specimen, believes that it represents a new genus; but in any case it is closely allied to Panoplosaurus (Lambe) and Ankylosaurus (Barnum Brown) from the same beds, and is not very unlike Polacanthus (Owen) from the Wealden of the Isle of Wight. The chief interest of the specimen lies in the preservation of the plated skin still in position over the greater part of the skeleton. The bony plates range from large broad-based spikes, presumably covered with horn in life, to minute specks in the wrinkled skin of the neck. The skin of the under surface has left no trace and was no doubt relatively thin. The vertebræ of the back lie in a straight line, and the ribs were probably fused to them, as in Ankylosaurus. The sacral vertebræ are fused to one another. The vertebræ of the neck and tail were movable. The limb-girdles are clearly shown, and the large bones of the left fore-limb clearly retain their natural position, indicating a squat posture with a bend at the elbow, so that the height at the shoulder was only about three feet. The left hind-limb has been bent over the belly, and is almost complete. The skull is missing. The length of the fossil is 15 feet, and its breadth 6 feet. In the absence of jaws and teeth, the feeding habits must be inferred from those parts in allied forms. Baron Nopcsa holds the view that the creature roamed a sandy desert and lived on occasional swarms of

locusts, the museum labels adopt the more usual interpretation of the Stegosaur teeth as adapted for vegetable food.

THE Trustees of the British Museum have recently placed in the Central Hall of the Natural History Museum a case illustrating the tragic effect on sea-birds of the waste oil which is allowed to escape from ships or is pumped out with bilge-water. The scene shows a portion of a beach on the south coast shortly after the turn of the tide, the sand in the foreground being still wet from the sea. At the high tide level lie six dead birds just as they have been washed up by the waves, together with the usual flotsam, while a little higher a guillemot, with glazing eye and panting breath, is evidently on the point of death. The feathers of the living and dead are heavily befouled with the thick dark liquid. A realistic touch is added by the two large flies which have already scented the dead bodies. Guillemot, razorbill, and red throated diver are the three diving birds represented. The scene reproduces with exact fidelity an actual group of dead birds which were washed up on the Isle of Wight. Such sights are, however, by no means confined to the shores of the English Channel, and may be seen in crowded waters all over the world where oil-burning vessels congregate. The prevention of the oil nuisance was considered at an international conference held at Washington this summer, and it is hoped that as the result stricter regulations will be enforced by the several maritime nations which will lead to an abatement of the nuisance. What precisely is the action of the oil on the birds which leads to their destruction is uncertain.

THE town council of Swindon has decided to purchase for the sum of 2150*l.* the small farmhouse and land adjoining the Marlborough road at Coate, about one and a half miles from the town, which was the birthplace of Richard Jefferies. Jefferies died in 1887, and, since his death, his name, which meant so little to his neighbours during his lifetime, has attained to a certain immortality in the big railway town The small house in Victoria Street, in which the early days of his married life were spent, is marked with a tablet recording that fact. There is a 'Jefferies Club' amongst the young people of the secondary schools, and the Field and Camera Club, as well as the flourishing branch of the Workers' Educational Association, regard him more or less as their patron saint. But as with so many others, so too with Richard Jefferies: he was no prophet to his neighbours whilst he lived, and only became one when he died. In truth, to country people the "common objects of the country" are so common that they do not appeal to them, as they do to the dwellers in towns. The study of natural history has its strongholds in the large towns and not in the country districts; and this is probably even more the case now than it was fifty years ago. But the influence of Richard Jefferies, for all that, lives to-day. It was he who for tens of thousands of town dwellers discovered the beauty of the Downs and the hanging wood of the chalk escarpment, which are the characteristic features of the country that he loved so well. He was not a scientific naturalist. He troubled himself not at all as to the minute points of distinction between sub-species and varieties, so beloved by many specialists of the present day; but he was a great observer, and what he saw he set down on paper and taught others to see too, and so may rightly claim to have been one of the chief founders of that 'Nature Study' which is now regarded as a necessary means of education.

A NOTEWORTHY event of the seventy-second meeting of the American Chemical Society, held on September 6-10 in Philadelphia, was the great pilgrimage of chemists to the grave and former home of Joseph Priestley at Northumberland, Pa. It was there, on the pleasant banks of the Susquehanna River, that Priestley, in 1794, then aged 61 years, joined his sons after religious persecution had made his life intolerable in England; and it was there that he spent the remaining ten years of his life engaged mainly in the study of theology and philosophy. He never became naturalised, saying that "as he had been born and lived an Englishman, he would die one, let what might be the consequence." The house which was built by Priestley at Northumberland in 1796 has acquired additional fame from the fact that it was the meeting place of a band of American chemists who assembled there in 1874 to celebrate the centenary of the discovery of oxygen, and to found an association which two years later developed into the American Chemical Society, now the largest chemical society in the world. In 1920 the house was in a sad state of decay, having been used during the War as a boarding-house for immigrant labour, but owing to the enterprise of the G. G. Pond Memorial Association it was purchased at public auction, thoroughly renovated, and a museum was erected on the lawn, which still bears two pine trees planted by Priestley himself.

THE ceremonies held at Northumberland on September 5 comprised a visit to the grave where Priestley, his wife, and seventeen descendants lie buried, an inspection of the house and of the museum containing original apparatus and other personal effects of Priestley; and a short meeting on the lawn at which addresses were delivered, by Dr. W. H. Walker on the history of the house, and by Dr C. A Browne, of the U.S. Bureau of Chemistry, on the life of the famous 'pneumatic' chemist, whose great-granddaughter, Mrs. Frances Priestley Forsythe, took part in the proceedings. Although England lost what America gained when Priestley emigrated to Pennsylvania, English chemists will always be grateful to their American colleagues for the way in which they have honoured and preserved his memory. Not all of them, however, will endorse the official reference to Priestley as "the founder of modern chemistry," great as his experimental achievements undoubtedly were. The number of famous chemists in different lands who have been awarded the title of 'founder' or 'father' of the science tends to become embarrassing, and it almost seems time to invoke the

Code Napoléon and put a ban on any further "recherche de la paternité."

IN a recent paper before the American Chemical Society, Dr. W. Blum, electro-chemist to the U.S. Bureau of Standards, stated that the manufacture of metal tubes and sheets by electrolytic means is fast becoming a reality. Although no details are given in the announcement before us, Dr. Blum is reported to have said that the possibility of continued manufacture on a commercial scale was not yet proven. In the past large sums of money have been spent on working out such a process, but the results have hitherto been disappointing, largely owing to the difficulties experienced in obtaining impervious deposits and uniform distribution of metal of the required structure and quality. These obstacles are now stated to have been overcome. Advantages claimed for the new process are ease in making complicated forms, and, unlike the rolling and drawing processes, thin-walled tubes are cheaper to manufacture than heavy ones.

THE future of petroleum supply is a problem that is interesting many countries to-day, and none more than the United States, which has been the chief producer and consumer since the industry began, and, it is said, is likely to be the first to have the wolf at the garage door Nineteen years has of late been the accepted probable life of the known petroleum deposits in that country, but a more pessimistic view was expressed by Dr. A. C. Fieldner, chief chemist to the Pittsburgh Department of the U.S. Bureau of Mines, in a recent address to the American Chemical Society at Philadelphia. According to this authority, the United States owns five-sixths of all the motor cars and trucks in the world, and consumes 80 per cent of all the motor-fuel, mainly petrol The oil-wells of proved extent are estimated to contain 5 billion barrels of readily available petroleum, a quantity which, at the present rate of consumption, would last only until 1936; the amount left in the oil-sands, which may be recovered when ordinary pumping is finished, is about 26 billion barrels. Supplies of proved extent could be made to last until 1943 if the yield of petrol from 'cracked' oils were increased from the 35 per cent. obtained in 1925 to 55 per cent., which is regarded as a likely figure; and they could also be conserved by using engines with a higher compression-ratio than that now in vogue in the United States (about 4 : 1). Looking to the future, Dr. Fieldner foresees the use of alcohol, derived from vegetation or obtained by synthesis, for mixing with petrol, but ultimately, he thinks that oil-shale, soft coal, and lignite will be the main sources of motor-fuel. Failing these, we may have to use a light electric storage-battery, or revert to Diesel's original idea and use coal-dust in our motor-engines.

PROF. SCHWARZ, in an undated volume, "The Kalahari or Thirstland Redemption," proposed an ingenious scheme for the development of the Kalahari Desert by flooding depressions to the west and east of Lake Ngami by dams across the Cunene River and the Chobi River above its confluence with the Zambezi. The southern Kalahari was expected to benefit by two overflow channels from the projected lake near Ngami to the Orange River, and the whole climate of South Africa to be improved by the moistening of the atmosphere by evaporation from the large water surfaces. To test this project the South African Government last year sent out an expedition under Dr. Du Toit, whose opinion will carry much weight. His report, of which an abstract was published by the *Times* of September 10, declares Prof. Schwarz's scheme impracticable, and emphatically rejects its axioms that there has been a progressive desiccation of South Africa within the last century, and that the reduction in the size of Lake Ngami was the result of that change. The new report concludes that the climate has not altered appreciably within historic times. Owing to heavy rains Lake Ngami, according to recent reports, is as large as it has been ever known.

THE Commission concludes that owing to the high rate of evaporation the water supplies on which Prof. Schwarz relies would be inadequate, and that for the establishment of any extensive permanent lakes the main flow of the Zambezi would have to be diverted by the erection of a dam 60 ft. high across the Zambezi at Katombora, which would submerge 4,600 sq. miles. A rejoinder by Prof. Schwarz severely criticises the report on the unconvincing grounds that the expedition did not go near the Kalahari and was not led by an engineer He declares that damming the Zambezi is "not practical politics," as the submergence of half Barotsiland and some native towns would be opposed to the Colonial Office insistence that there must be no interference with native rights. Considering, however, what has been submerged by the Nile dams, the transference of native settlements would not be a serious objection to any scheme for the better utilisation of the waters of South Africa, especially as due compensation to the natives, apart from the improved value of the rest of their land, would no doubt satisfy the Colonial Office stipulations as to native rights. The report of Dr. Du Toit, as one of the leading geologists and geographers in South Africa, will doubtless receive careful consideration.

IN the *Wireless World* for September 1, Col. Crawley gives a survey of the overseas radio services in Great Britain. He proves that, so far as radio communication is concerned, the position is satisfactory. We are now on the eve of a complete system of Imperial radio communication. The control of all the overseas commercial messages is in the hands of the Government and the Marconi Company, but the military messages are controlled by the three fighting services. The Post Office services are operated from the London General Post Office, on the roof of which eight receiving aerials are installed. To obviate the effects of local electrical interference, however, this receiving station will shortly be transferred to St. Albans. The messages

received are relayed to the recording machines in the same building. These machines are placed alongside the transmitting machines which actuate the sets at Rugby, Oxford, Northolt, Stonehaven, Dollis Hill, and Caister. When the St. Albans station is ready the received signals will be relayed to the General Post Office.

THE Rugby station, with a frequency of 16 kilocycles, transmits messages to stations and ships all over the world. It is hoped also to inaugurate shortly long-range radio telephone services. The station at Leafield, near Oxford, communicates with Halifax and Cairo, both by an electric arc (24·21 kilocycles) and by a valve set (6000 kilocycles). The station at Cairo is operated by the British Post Office and communicates with Oxford, Germany, France, Italy, and Basra. At Northolt there are two aerial systems, one a valve set and the other an arc set. This station communicates with Czecho-Slovakia, Italy, and Hungary. Stonehaven communicates with Germany, Norway, Iceland, Poland, and Esthonia. Caister communicates with Holland when the cable service is interrupted, but it is normally closed. Dollis Hill is the Government experimental station. Last year the Post Office point-to-point services dealt with over ten million words of paid traffic. The Marconi Company operate an alternator station at Carnarvon and a group of valve stations at Ongar. They have a large receiving station at Brentwood. Considerable extensions are in progress. They erect the beam sending and receiving stations for the Post Office; the transmitting station at Bodmin and the receiving station at Bridgwater are practically completed.

THE Royal English Arboricultural Society held its summer meeting recently at Newcastle, with Mr. Leslie S. Wood as president and Mr. Gerald W. E. Loder, vice-president. The secretary, Mr. Edward Davidson of Haydon Bridge, had arranged a programme of excursions to Middleton Hall, Chopwell, and Healey. The woodlands were evidence of the energy of those responsible—Messrs. Gerard F. T. Leather, A. D. Hopkinson, and W. St. A. Warde-Aldam. Outdoor discussions were shared by foresters, estate agents, timber merchants, nurserymen, and university lecturers. South country visitors were surprised to see little planting of ash, elm, sycamore, though these with birch and mountain ash come by natural regeneration. The timber merchants' control demands conifers for pit props, especially larch. Sitka, Douglas, Corsican, Japanese larch are being tested by the acre. Pre-War plantations are thriving. Even in war-time some planting was achieved. Post-War planting has struggled against increase of rabbits and a legacy of forst weeds, gorse, bracken, and bramble. Gorse has been twice cut, and the trees may now outgrow it. Bracken has grown apace this year, cutting seems necessary. The blackberry-picking problem is accentuated when the forest is on the edge of an unemployed mining village. One estate was remarkable for continuity of management —only three foresters in a century; another for the high qualifications of its officers although their reigns have been short; a third for the skilfully arranged economies of an estate railway, sawmill and woodwork shops, the engine fed by gas generated from scrap and sawdust.

A REMARKABLE find of Mycenæan treasure is described by Mr. A. J. B. Wace in the *Times* of September 10. The Swedish Archæological Expedition to Greece, in excavating a beehive tomb near the village of Dendra, which lies at the foot of the acropolis of the Homeric Midea in the neighbourhood of Nauplia, has discovered four grave-pits, two of which are undisturbed. This is the only untouched burial hitherto found in a beehive tomb, excepting that at Vaphio from which the famous Vaphio cups were obtained. In one of the undisturbed pits lay two extended skeletons, one male, the other female. In the second was a female skeleton. The 'king' was covered almost from head to foot with gold, silver, and other riches. On his breast was a magnificent golden cup, 18 cm. in diameter, cunningly chased with what is described as "almost . . . a submarine seascape," the figures including argonauts, dolphins, and four octopuses. Artistically and technically the cup is a masterpiece. In the cup were the king's seals, and on or by his body were bronze swords with hilts of gold, or ornamented in gold, silver vases, a gold cup sheeted with silver, a bronze vessel, knives and spearheads. With the 'queen' lay a splendid gold cup sheeted outside with silver inlaid in gold, bronze, and black silver Other treasures were a necklace of 61 gold beads, a lamp of steatite and a vase of ostrich-egg with applied ornament in gold, silver, and bronze. The 'princess' was less richly supplied, but had a gold ring, a necklace of 38 gold beads of rosette form, and the remains of a girdle. All the finds, excepting the 'king's cup,' are of a comparatively late date, on the ceramic evidence scarcely earlier then 1350 B.C. The older cup, it is suggested, may be an instance of the burial of an heirloom or antique, in which case, Mr. Wace points out, it indicates caution in accepting theories recently put forward that the beehive tombs should be dated much earlier than they usually are.

PROF. V. H. BLACKMAN, Prof. F. G. Donnan, and Prof. F. A. Lindemann, have been appointed by Order of Council dated August 20, 1926, to be members of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research, in succession to members who have retired on the completion of their terms of office

THE ninth International Congress of Zoology, held at Monaco in March 1913, decided that the tenth Congress should take place in 1916 at Budapest, with Dr. G. Horváth, Hungarian National Museum, Budapest, as president. The War rendered the meeting impossible. The international situation, however, has now so much improved that the Congress need no longer be postponed. After due consultation with members of the permanent committee of the international congresses of zoology,

Dr. Horváth is able to announce that the tenth Congress will meet at Budapest on September 4-9, 1927, and he cordially invites all zoologists and friends of zoology to attend. The detailed programme of the Congress will shortly be issued and sent to all who are interested.

A SERIES of Sunday afternoon addresses under the general title of "The Contribution of Science to Human Life" is to be given during the autumn at the Guildhouse, Eccleston Square, London, W. The lectures are free, and no tickets are required. The lecturers and their subjects are as follows: Oct. 3, Sir Richard Gregory, the worth of science; Oct. 10, Dr. Bernard Hollander, sound and unsound mind; Oct. 17, Sir Sefton Brancker, the scientific problems of commercial aviation; Oct. 24, Dr. W. A. Bone, the economic aspects of coal; Oct. 31, Prof. H. H. Turner, the fight against fear; Nov. 7, Dr. W. H. Eccles, the influence of wireless on modern life; Nov. 14, Dr. E. E. Fournier d'Albe, eyes and ears of the future; Nov. 21, Dr. G. C. Simpson, meteorology in the service of man; Nov. 28, The Right Hon. Viscount Haldane, the wider meaning of relativity; and Dec. 5, Sir George Newman, the contribution of medical science to human life.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant in the anatomy department of the University of Aberdeen—The Secretary (September 27). A head master for the Eye Grammar School, graduate, science preferred (with agricultural bias)—W. E. Watkins, Hon. Clerk to the Governors, County Hall, Ipswich (September 29). A joint keeper of archæology in the National Museum of Wales and lecturer in archæology in the University College of South Wales and Monmouthshire—The Director, National Museum of Wales, Cardiff (October 16). A senior lecturer in zoology and physiology at Huguenot University College, Wellington, Cape Province, South Africa—The High Commissioner for South Africa, Trafalgar Square, W.C.2. A laboratory attendant for histology in the anatomy department, University College, London—Prof. J. P. Hill, Anatomy Department, University College, Gower Street, W.C.1.

Our Astronomical Column.

THE METEORIC PHENOMENA OF SEPTEMBER 6.—Mr. W. F. Denning writes that a large number of observations have been received of apparently two large fireballs which illuminated the sky in many parts of England on the evening of September 6 at about $20^h\ 30^m$ and exactly at $20^h\ 45^m$ G.M.T. respectively. The data collected have not yet been thoroughly discussed and will necessarily take some time. The first meteor appears to have travelled from a southern radiant northwards and was observed at places so distant as Wanstead, near London, Durham, the south-west of England, and Sunderland. It gave a considerable light and some persons mistook it for lightning, but its motion to north dispelled the idea.

The second meteor made its apparition about 10 or 15 minutes later, and was no doubt the most brilliant object of the pair. Its path was also to the northwards, and it terminated its career by a series of loud detonations when it was some miles south of York. This meteor appears to have given several flashes of dazzling brilliancy; for some observers compared its light with that of the sun. For a moment or two it illuminated the landscape as it is at noonday. Some fragments of this object may possibly have fallen to the ground unobserved in the north-east region of Yorkshire, but no evidence of actual stonefalls has been received. In the district of Selby, and Goole, Yorkshire, the height of the fireball was about 26 miles, and it was decreasing.

The first object seen on September 6 appears to have been of very unusual size and aspect. Did it represent anything of similar nature to the auroral beam which passed over England on November 17, 1882?

THE UNIFORMITY OF THE EARTH'S ROTATION.—M. Bigourdan, of the Paris Observatory, contributes an article to *Comptes rendus de l'Académie des Sciences* for August 30, in which he points out that the comparison of the clocks of a large number of observatories by the aid of wireless time-signals distributed from Bordeaux-Lafayette, Saïgon, Honolulu, and Washington, should afford a very delicate test of the uniformity of the rotational movement. It is not even necessary for this purpose to await the determination of the errors of the different clocks, provided that their daily rates are uniform to 0·01 sec. or thereabouts. Comparison of 100 such clocks will permit the testing of the uniformity of rotation to the order of 0·001 sec. The present time is particularly appropriate, as the International Astronomical Union has arranged for a general series of wireless longitude determinations to be made between October 1 and November 30 next.

A very large number of signals will be recorded at each observatory, but a small number will suffice for M. Bigourdan's purpose, and he asks that observers will communicate to him the Bordeaux-Lafayette signals Nos. 113-122 and 235-244, that is, those just preceding $20^h\ 3^m\ 0^s$ and $20^h\ 5^m\ 0^s$ of Universal Time. The uncorrected clock times of reception of the signals will suffice, and they need only be sent for the period of 30 days, commencing on October 15. It will be remembered that many astronomers, including Prof. E. Brown, now attribute the unexplained irregularities in the moon's motion to changes in the earth's rate of rotation. The inequalities that M. Bigourdan wishes to examine are of much shorter period than these, but analogy leads one to expect that if inequalities are present at all they may have many different periods.

MR. WILK'S COMET ANNOUNCEMENT.—It has now been confirmed that a motion among the stars of a degree in 4 minutes of time was the correct interpretation of the telegram from Cracow Observatory referred to last week, p. 388. Since no further observations have been received, it is evident that the material is insufficient to pronounce definitely in favour of the cometary nature of the object. It may have been a patch of aurora or the trail of a meteor in the upper atmosphere.

Prof. Perrine and his assistants observed a somewhat similar object at Cordoba in May 1916. In that case also its nature remained doubtful, but Miss Glancy showed that, if a comet, it must have approached very near to the earth (even closer than the moon).

Research Items.

THE MAGLEMOSE CULTURE. — Some interesting observations on the genesis of the Maglemose culture were made by the Abbé Breuil in a communication to the Institut Français d'Anthropologie, and are now published in *l'Anthropologie*, T. 36, Nos. 3-4, *à propos* of a characteristic harpoon from Béthune, dated 1840, now in the British Museum. Similar harpoons from the Béthune marshes and from Isbergues near by are recorded. Deer's antlers, pierced and ornamented, from the Somme and Paris described by Acy afford further incontestable evidence of Maglemose influence. Several examples of Maglemosian harpoons have come from Belgium; but in the Musée d'Histoire Naturelle of Brussels are a number of unpublished harpoons found by M. Lequeux in mixed Tardenoisian-Maglemosian sites, and quite recently investigations still going on have brought to light harpoons in which the barbs are made of Tardenoisian triangular implements. A harpoon ornamented in Maglemosian style has also been found at the proto-Tardenoisian level of the Remonchamps site. The opinion already expressed, though not accepted by Scandinavian archæologists, that while Maglemose is related to the Magdalenian, but not directly descended from it, being rather a result of a combination of Magdalenian and eastern elements coming from the direction of the Urals, has received support from the discovery at Wercholensk, near Irkutsk, of an Upper Palæolithic site with harpoons. While the harpoon is a link between Magdalenian and Maglemose, the difference in the decorative art precludes close connexion Even the style of the harpoons found on the peripheral Magdalenian sites of Central and Eastern Europe, like the decorative art, have distinctive characters indicating important ethnic differences. A composite origin for Maglemose is therefore suggested, including provincial Magdalenian of Central Europe, oriental (decorative motives and Campignian forms), a Southern or Mediterranean influence (Tardenoisian), and possibly a late Palæolithic from Scandinavia when Norway was free from ice during the latest oscillations.

PHYSICAL ANTHROPOLOGY OF THE JAPANESE.—A study of the cephalic index and the stature of the Japanese, by Akira Matsumura, is published by the Imperial University of Tokyo as Vol. 1, Pt. 1 of Section 5, Anthropology, of the *Journal of the Faculty of Science*. The chief point that this study serves to emphasise is the marked differences in head form and stature which are to be found among the population. The Japanese, both men and women, are brachycephalic, the men slightly less so than the women, but the mean values of the cephalic index according to locality differ from province to province. The variability in head measurements also differs from province to province. On the whole, the south-western district, which has received the benefits of culture from ancient times, is more variable than other parts where civilisation arrived later. In head-length, head-breadth, and cephalic index, the Japanese differ from the Ainu and Koreans. They appear to resemble closely the people of eastern Siberia and south China. As regards variation, however, the Japanese are less variable than the Koreans in head measurement; but sensibly more so than the Ainu. The stature of men and women has shown a tendency to increase slowly during the last ten years. The variation in stature as between provinces is marked, but not so much as is the cephalic index. The relation of stature to cephalic index is also different for each province. As in the case of head-form, the Japanese in stature resemble the peoples of eastern Siberia, south China, and Indo-China, and not the Koreans or the Ainu. By combining the stature and cephalic index, grouped according to the significance of the differences between means, it is found that the Japanese fall into nine different local groups.

THE EFFECT OF THE GROUP ON MENTAL WORK.—In the *Indian Journal of Psychology* (vol. i. No. 2) N. N. Sen Gupta and C. P. N. Sinha report an interesting piece of research on mental work done in isolation and in the group. Five subjects took part in the experiments and the test employed was the well-known cancellation. The same column taken from a number of copies of a daily paper was given to each subject and he was asked to cancel all the 'a's' and 'e's' for a period of three minutes. Each subject did the test several times alone and also as a member of the group. The writers exercised the frequently neglected precaution of securing that adequate practice had taken place beforehand. The results show a significant difference in favour of working in the group. The reasons for this result cannot yet be given. It would be necessary to know whether other subjects gave the same result, how long such group stimulation could operate, whether different types of people reacted differently. It is a commonplace in industrial occupations that some people prefer to work alone while others dislike it. From the statistical point of view, we would suggest to the writers that the standard deviation or probable errors should be inserted. In this case all the details are given and the reader can work them out, but with larger numbers that would not be possible.

TERTIARY MOLLUSCAN FOSSILS FROM KOREA.—Comparatively little is known concerning the Tertiary invertebrate fauna of Korea, but Jirô Makiyama is now able (*Mem. Coll. Sci. Kyoto Imp. Univ.*, Ser. B, vol. 2) to add somewhat to our knowledge regarding the mollusca. His specimens came from beds in the neighbourhood of Meisen, North Kankyô-dô, which have been divided by the Japanese geologists into two groups: a lower, or Ryûdô group, which contains a rich flora of the so-called 'Arctic Miocene,' and an upper or Meisen group. This last is further subdivided into three members: in ascending order, the Heirokudô, the Kanchindô, and the Mankodô. These J. Makiyama, from their fossil molluscan contents, is lead to infer belong respectively to the Upper Eocene, the Oligocene, and the Lower Miocene. The author comments on the fact that some of the Korean forms recall corresponding ones from Europe, from Nigeria, and California, but none resembles those from the Eocene of either India or Java. The main part of the paper contains the descriptions of the sixteen new species, which form the bulk of the material, and are figured on two well-executed photo-litho. plates.

LAND MOLLUSCA OF PANAMA AND COSTA RICA.—Considerable interest attaches to the land molluscan fauna of southern Central America on account of the light its study should yield as to the region where the typical North American assemblage gives way to that of South America. Dr. H. A. Pilsbry (*Proc. Acad. Nat. Sci.*, Philad., vol. 78) describes and gives a catalogue of all the Panamic land mollusca, including that of the Canal Zone. Seventy-seven species and three subspecies, including nine new species and five new subspecies, referable to thirty-one genera are now

known from this area. Their geographical relations are set forth in a table with indications of the northern and southern limits of the genera and species. It results that thirty-four species have been found only in Panama and the Canal Zone; twenty-four also occur northward; thirteen both north and south; and six species only southward. From these and other statistics it appears that while the transition between the South American and tropical North American faunas is gradual, some genera of each region penetrating far within the other, the change is most rapid in a comparatively short section of the isthmus at and immediately east of the Canal Zone. Some modification, however, may be expected with further research, which may even double the present number of species. Appended are notes on the classification of snails from Mexico to Columbia, referred by authors to Microphysa and Thysanophora. Four new genera, six new subgenera, and three new species result from this investigation. The foregoing is followed by descriptions by the same author of Costa Rica land shells collected by A. A. Olsson. It is a short communication, but yields one new genus, four new species, and one new subspecies. Excellent figures throughout the text and on three plates illustrate the two papers.

A SMALL ULTRA-VIOLET SPECTROSCOPE.—For the convenience of those using ultra-violet light, Messrs. R. and J. Beck have introduced a small quartz prism spectroscope which can be held in the hand and requires no source of light other than that to be observed. The spectrum is formed on a fluorescent screen so that the lines are visible. The scale is in Ångström units and extends from 2000 to 4500, each 100 units being marked.

INTERMITTENCY IN PHOTOGRAPHIC EXPOSURES.—Mr. Raymond Davis, photographic technologist in the Bureau of Standards, Washington, finds that if the exposure is intermittent, such as is produced by the rotation of a sector wheel in the incident light, an equivalent exposure, as compared with the effect on development of a continuous exposure, may give either a gain or a loss (or an intervening zero effect) in the resulting density, according to the intensity of the illumination. That a more intense light gives a gain "has not been heretofore brought out." As an explanation of this result he suggests that the action of light on the silver haloid is not a single step or simple conversion into the developable image, but that there are two actions going on simultaneously which produce respectively a lessening and an increasing of the recipient exposure effect, the more intense light favouring the increase and the feebler light the decrease, during the intervals of nonexposure of an intermittent exposure. These results vary with the nature of the emulsion and the illumination, as well as with the number and duration of the intervening nonexposure periods. The experiments suggest that with illumination intensities higher than 4-candle metres, the growth of the exposure effect during the intervals would probably exceed the fading in all cases.

GASEOUS COMBUSTION AT MEDIUM PRESSURES.—Experiments by R. W. Fenning on air-fuel explosions in closed vessels have been in progress at the National Physical Laboratory during the last five years, and the results relating to carbon monoxide and methane have been published in No. 998 of the Aeronautical Research Committee's reports and memoranda. Two investigations are described, the first deals with the effect of hydrogen-air mixtures and water vapour on carbon monoxide-air explosions in a closed vessel, and the second relates to explosions of methane and air over a range of temperatures and pressures. The report includes tables of explosion temperatures and pressures, and the results are illustrated by reproductions of indicator diagrams under various conditions.

COPPER HYDRIDE AND ITS CRYSTAL STRUCTURE.—The *Journal of the Chemical Society* for July 1926 contains an interesting paper by H. Müller and A. J. Bradley on copper hydride and its crystal structure. *Cuprous* hydride was prepared by a method similar to that of Wurtz, namely the interaction of hypophosphorous acid and copper sulphate. The ratio of copper to hydrogen was determined by combustion, or by a method analogous to the Schiff nitrogen estimation, and was found to agree with the formula CuH. X-ray diagrams were obtained by the Debye powder method and the crystal structure was shown to be hexagonal close-packed with an axial ratio of 1·59-1·60. The X-ray spectrum of the substance obtained by the reduction of copper oxide with hydrogen, or the action of hypophosphorous acid on copper sulphate and copper oxide, which was considered to be *cupric* hydride, corresponded exactly with the spectrum of a mixture of copper and copper oxide. In conjunction with other evidence, the results of these experiments cast considerable doubt on the existence of *cupric* hydride.

THE CATALYTIC DECOMPOSITION OF NITRIC OXIDE.—When exposed to heated platinum wire at temperatures from 1000°-1500°, nitric oxide decomposes into nitrogen and oxygen; and if the products are allowed to cool before the reaction is complete, nitrogen peroxide is formed from the unchanged nitric oxide. This involves a diminution in volume, and the maximum contraction occurs when the oxygen produced is sufficient to combine with all the residual nitric oxide. A paper in the July issue of the *Journal of the Chemical Society* describes the temperature and pressure measurements made by T. E. Green and C. N. Hinshelwood, which prove that the order of the reaction $2NO = N_2 + O_2$ is unimolecular with respect to nitric oxide. It is uninfluenced by nitrogen but retarded by oxygen. Jellinek has shown that the ordinary thermal decomposition is bimolecular; this is, therefore, an example of a reaction which is bimolecular in the gas phase becoming unimolecular at the surface of the catalyst.

ACTIVE NITROGEN.—There are two views as to the nature of the active modification of nitrogen which is produced when an electrical discharge is passed through the gas at low pressures: that it consists either of atoms or of metastable molecules in an excited form. E. J. B. Willey and E. K. Rideal conclude from their experiments on the heat of formation of active nitrogen, which are fully described in the *Journal of the Chemical Society* for July 1926, that metastable molecules are the cause of the activity. The heat of formation was calculated by measuring the rise in temperature in a calorimeter, first when active nitrogen reacted with nitric oxide and secondly when the gas underwent catalytic decay in the presence of the air. By means of a calibrated heating coil in the calorimeter, the temperature changes observed in these experiments were reproduced and the heat equivalent of the reactions obtained. The mean value for the energy content of the active nitrogen was found to be 42,500 cals. per g.-mol.

Patent Office Statistics.

THOSE who are interested in the industrial applications of science will find much that is worthy of their attention in the recently published report of the Comptroller-General of the Patent Office for the year 1925. The report consists entirely of statistics, so that, in the absence of any official commentary, an attempt to analyse some of the figures and to compare them with those given elsewhere may perhaps be of value, for the relation between invention and industrial prosperity is an intimate one. Further, it is of interest to assess the quality of the services rendered to the State by the Patent Office, not only because this is essentially a scientific department, but also because it has been felt for some time past that the Patents Acts cannot be left where they are: and the question whether the desired improvements are practicable is one which depends in great measure on the degree of efficiency with which the existing system is being administered.

The number of applications for British patents filed during 1925, namely, 33,003, exceeded the numbers filed during 1923 and 1924 by 1·1 per cent. and 5·2 per cent. respectively, the corresponding excesses in the case of the United States being 4·3 per cent. and 4·2 per cent. respectively. Too much importance should not be attached to these figures, however, for fairly wide fluctuations are common even in normal times. In fact, when averaged over several years, the annual input of patent applications appears to depend, for countries having comparable patent and industrial systems, mainly on the population of the countries considered: thus, the number of applications per 10,000 of the population is, under normal conditions, roughly 7·5 in Great Britain, 7·3 in the United States, 7·2 in Germany, and 8·7 in Switzerland. In France, however, which is more extensively agricultural and has a backward patent system, the corresponding figure is only 4·8. It is contended by the United States Commissioner of Patents that fluctuations in the input of patent applications are in some sort an index of fluctuations in national prosperity: and though his contention would require considerable qualification before it could be generally accepted, the upward trend of inventive enterprise in Great Britain is satisfactory so far as it goes. The number of patents actually sealed in 1925 was about 52 per cent. of the number of applications filed, and 88 per cent. of the number of complete specifications filed. These figures indicate the extent to which worthless patents are weeded out by the official examination and various other causes, but no figures are given which would enable us to judge the effect of the official examination on the drafting of the specifications finally issued; nor is any information given as to what the United States Commissioner calls the 'gain in dates.' In the United States, the average time which an applicant had to wait for the first official action was reduced in the course of the year from 4·5 to 2·6 months, and the delay in dealing with amendments from 3 or 4 to 2·3 months. Promptness in the issue of patents is of such importance that it would be of interest to the public to know how far the British office has been able to make good the ground lost during the War. It is to be noted that the examining staff has been reduced in strength from 260 in 1913 to 241 in 1925: such economies are desirable in themselves, but the 'gain in dates' is of greater importance, and the public might with advantage be allowed to know how this matter stands.

As regards the nationality of applicants for British patents, it is to be noted that the percentage of these residing in Great Britain fell from 75 per cent. in 1923 to 69·8 per cent. in 1924 and 68·1 per cent. in 1925: at the same time the percentage residing in the United States rose from 8·2 per cent. to 8·9 per cent. and then to 9·6 per cent. Further, it must be remembered that only the best of the foreign inventions will be considered worth patenting outside their country of origin, and consequently the great majority of applications coming from abroad lead to the actual grant of patents. Thus in 1923 (the latest year for which complete data are available) 16 per cent. of the patents actually granted (as distinct from mere applications) were granted to persons residing in the United States, and only 57 per cent. to persons residing in Great Britain: for the previous year the corresponding figures were 15·5 per cent. and 59 per cent. respectively. Of the patents issued by Germany in 1923, 80 per cent. were granted to Germans, 2·1 per cent. to Britons, and 2·8 per cent. to Americans, while Germans took 6·5 per cent. of the British patents and 2 per cent. of the United States patents. These figures are not likely to change greatly, in the absence of unforeseen causes, for they must be ascribed mainly to differences in population between the countries concerned: thus, in the year 1923, while 3 out of every 100,000 Britons took United States patents and 2·3 took German patents, 2·5 out of every 100,000 Americans took British patents and 1·2 took German patents, and 1·6 out of every 100,000 Germans took British patents and 2·4 took United States patents. Out of every 100,000 Frenchmen, 2·5 took British patents.

For the year in question, 6615 or 43 per cent. of the British patents were taken by foreigners, while the corresponding figures for the United States were 4465 or 12 per cent., and for Germany 9127 or 20 per cent. The German patent is thus the most popular among foreigners, as judged by the absolute figures, and its popularity is not due to abnormal economic causes. In 1912, for example, when Germany issued fewer patents than now, 4251 or 32 per cent. of these were granted to foreigners. (The German '*gebrauchsmuster*' are excluded from the preceding figures.) But when we consider *percentages* we find that not much less than half of the monopolies which Great Britain grants for the manufacture and sale of goods within her borders are granted to persons residing outside the country: and we find that this state of things, depending as it does on differences of population, is likely to continue. It is to the advantage or the disadvantage of British industry according as the monopolies granted will be used for the purpose of developing new industries in Britain, or for the purpose of obstructing British manufacture in favour of imports. Examples can be cited in which each of these effects has been produced, but no general statistics are available for ascertaining the balance of good or ill which at present results from the grant of patents to foreigners. The Acts provide that where a patent is being obstructively used, an interested party may apply to the Comptroller-General for the compulsory grant of a licence to work the patent, or for its revocation: but in 1925 *only two such applications were made, and one of these was withdrawn.* It may be mentioned in passing that of the patents granted by Canada, about 70 per cent. are held by persons residing in the United States.

While the Patent Office is not empowered to make an exhaustive investigation into the validity of the patents which it grants, it does make an investigation of limited scope which is relevant to validity: and the Comptroller-General has powers which constitute

him a court of first instance for the trial of certain legal issues. It is of interest, therefore, to see with what degree of efficiency the Patent Office discharges its legal functions. The report before us shows that in 1925 the Comptroller-General, or rather three senior members of the corps of examiners who appear to have acted for him, gave decisions in over 2000 'hearings' under various sections of the Patents Acts, and in 84 'oppositions' brought by interested parties against patents provisionally granted. The quality of the work done in these cases can best be gauged by reference to the decisions of the Law Officers of the Crown, to whom a cheap appeal lies from the findings of the Patent Office. It appears that 27 appeals against the 'opposition' decisions of 1924 and 1925 were disposed of during the year, the official decision being vindicated in 20 cases (including 4 cases of withdrawal), varied in 2 cases, and reversed in 5. The appeals against 'hearing' decisions which were disposed of during the year numbered 42: the official decision was vindicated in 34 cases (including 3 cases of withdrawal) and reversed in 8. Actual figures for the number of hearings held during the year are given for only three sections of the Acts: the number of hearings under these sections was 2088, of which 0·33 per cent. gave rise to successful and 0·86 per cent. to unsuccessful appeals As regards the work of the corps of examiners as a whole, it is to be remarked that while 19,434 complete specifications were examined and 17,199 patents sealed during 1925, the official actions taken have now been accepted by all concerned except in the case of 11 successful and 5 outstanding appeals, unless any further question should arise upon them in the High Court.

In the financial section of the Comptroller-General's report the tables of receipts and expenditure are fairly complete, and take account of such items as depreciation of buildings, the estimated value of pension rights, and the upkeep of the public library; but a more precise statement of the distribution of the staff would be of interest when it is desired to estimate the cost of changes in the patent system. Of the revenue 82 per cent. is derived from Patents fees, 2·4 per cent. from Designs fees, and 9·9 per cent. from Trade Marks fees. The total of Patents fees, namely, 391,677*l.*, is made up of items which may be divided into three groups. The first group comprises items which are likely to give a fairly constant yield in future years, namely, the initial filing and sealing fees (28 per cent. of the whole), renewal fees for the 5th, 6th, and 7th years (24 per cent.), and miscellaneous fines and fees (9 per cent.). The total of these, accounting for 61 per cent. of the yield of patents fees, may be regarded as normal. Renewals for the 8th to the 11th year (of war-time patents) are affected by the War, and their total (18 per cent.), being abnormally low, will improve during the next few years. Renewals for longer periods (21 per cent.) do not yet show the effect of the War, and their yield will therefore fall off for a few years to come. On the whole, therefore, revenue is likely to be stationary, and in the absence of new expenditure the inventor will continue to pay large sums in relief of general taxation. The surplus was 75,203*l.* in 1924 and 88,540*l.* in 1925, after accounting for all imaginable charges and meeting the deficit on publications and the upkeep of the library, which represents a service to the general public. The United States Treasury, on the other hand, subsidised the American Patent Office to the extent of 81,720*l.* in 1924 and 68,150*l.* in 1925, so that the United States subsidises invention to nearly the same extent that Great Britain taxes it.

The financial section of the report is also relevant to the degree of efficiency with which the Patent Office is administered, for under the prevailing conditions the most rigid economy is incumbent, as a patriotic duty, upon public departments. It is extremely difficult to find a standard by means of which administrative economy may be measured, but we can obtain some idea as to how far an economic spirit prevails at the Patent Office by comparing its present scale of staffing with that which obtained before the War, with that which obtains in the United States, and with that which obtains in other comparable Government Departments in Great Britain. We find that whereas the number of patent applications per annum has increased by 10 per cent. as compared with 1913, the strength of the corps of examiners has decreased by about 8 per cent., so that each member is on the average dealing with 20 per cent. more applications now than before the War. The salary bill for this section of the staff is not distinctly shown, but if we estimate the cost-of-living bonus from the average salary and then assume that (in accordance with the Ministry of Labour index) 1*l.* in 1925 was equivalent to 0·57*l.* in 1913, the 'real' or purchasing value of the salary bill appears to have decreased by 6 per cent. As regards the auxiliary staff, there is no sign of any increase in strength or cost disproportionate to the increase in work done, the 'real' salary bill for the whole office being 2 per cent. more than that for 1913. The staffing is roughly on the same scale as that of the United States Patent Office. In each case there are 130 to 140 patent applications per annum per member of the corps of examiners, and the duties in the two cases, though not identical, are probably comparable. Our third comparison may conveniently take the form of a table, the contents of which have been compiled from the Estimates (Class II.) for 1926–7:

Department.	Total staff.	Number of posts with salaries rising to a maximum of		Total of higher posts.	Percentage of higher posts.
		1000*l.* to 1800*l.*	2000*l.* and more.		
Treasury	331	21	11	32	9·7
Foreign Office	830	25	3	28	3·3
Ministry of Transport	524	11	2	13	2·5
Board of Trade (Head Office)	667	8	5	13	1·9
Ministry of Agriculture	1207	14	3	17	1·4
Patent Office, with Trade Marks and Designs Branches	685	4	0	4	0·38

From the point of view of economy, attention may also be directed to the large amount of judicial work performed by the Hearing Officers, as set out above. For men who doubtless have other important duties to perform, the record of 2172 hearings and oppositions is a remarkable one.

The outstanding inferences to be drawn from the Comptroller-General's figures appear, then, to be that an enormous proportion of British patents is held by foreigners, while manufacturers take no advantage of the existing facilities for the grant of compulsory licences; that the legal work of the Patent Office is admirably performed; that the Office is administered in a spirit of economy which deserves particular attention; and that a large annual surplus is available for the improvement of the patent system when this step is considered desirable.

The Royal Photographic Society's Exhibition.

THE Royal Photographic Society's Annual Exhibition is now open at the Society's House, 35 Russell Square, London, admission being free; and it closes on October 9. In the Scientific and Technical Section the items that seem to be the most novel or the least often seen are some results obtained by a combination of the cinematograph and microscope, and a photograph of the ultra-violet spectrum of silicon by Prof. A. Fowler, of the Imperial College. This is done in sections, from wave-length 2820-2420 Å.U. on ordinary plates, from 2250-1840 Å.U. on plates smeared with a fluorescent oil, and from 2150-1250 Å.U. on Schumann plates using a vacuum grating spectograph.

Cinematography is more fully represented than it has been before. Dr. S. Bayne-Jones shows the life-history of the Penicillium, taking the pictures at the rate of two per minute by means of an automatic mechanism which also turns on the light. Dr. S. E. Sheppard and Dr. R. H. Lambert, of the Kodak Research Laboratory, have photographed the electrophoresis of rubber latex particles, the film showing the Brownian movement of the particles and their movements in an electric field. Mr Loyd A. Jones, also of the Kodak Research Laboratory, has studied the growth of crystals using elliptically polarised light and the 'Kodachrome' process, and he contributes films of six different substances in very realistic colours. There are several other films of the more usual type and also a collection of historic films, including the famous train film of Lumière Bros., which was the first ever exhibited to a paying audience (in 1895). Photo-micrography is associated with colour processes in the four autochromes of Dr. C. F. Elam, of the Royal School of Mines, which show at a magnification of × 100 various crystalline forms of silver nitrate taken between crossed Nicols. Dr. L. F. E. Johnson, besides two slides taken in a similar way, has two illustrations of fabrics as they appear under the microscope when illuminated by Rheinberg's differential colour stop, which shows the warp red and the weft blue.

Of the numerous photo-micrographs taken in the usual manner we would direct attention to Dr. G. H. Rodman's series of 24 which illustrate the various forms of hairs occurring on plants which are recognised as liable to produce mischief (sting, etc.) in those who come in contact with them; Mr. J. H. Pledge's 9 photographs (× 10) of an Indian mistletoe that has no leaves; cultural types of meningococci and gonococci from the Lister Institute of Preventive Medicine; and a series of the rabbit embryo in utero and rabbit placenta, each showing various stages in its development, by Mr. G. S. Sansom. There are many others of considerable merit and interest, and a large collection that shows the present results of metallography obtained in numerous laboratories where it is practised, including the National Physical Laboratory. Viewing the photo-micrographs as a whole, the difficulty of getting good results at certain rather low magnifications seems to have been entirely overcome, and they indicate that no more detail is obtained by increasing the magnification above about × 2000.

Radiography and photographic printing in colours are as well represented as ever. The structure of emulsions, and the changes produced in the silver bromide grains, are shown by Mr. L. F. Davidson and the British Photographic Research Association, and Mr. L. E. Jewell shows the advantage of what he calls 'relief illumination' in photo-micrography, that is, the mirror in the vertical illuminator is considerably decentred so that there is a mixture, in regulatable proportions, of oblique specular and diffused light. The General Motors Corporation of Michigan, U.S.A., contributes prints of its Midgley Optical Gas Engine Indicator, which records as curves the character of the combustion in automotive engines. Of the various trade exhibits, those that impressed us most were Messrs Ross's rapid speed photographs of the last test match taken with a 40-inch *f*/8 Teleros lens from outside the ground, and Messrs. Ilford's illustrations of the method of making and testing their light filters

Smoke Abatement Conference.

A CONFERENCE on smoke abatement was held in Birmingham last week, organised by the Smoke Abatement League of Great Britain, in connexion with an exhibition of apparatus and methods bearing upon fuel economy and the abolition of smoke. The conference was divided into two main sections, one of which dealt with the industrial, and the other with the domestic, smoke problem. On the morning of September 7, Mr. J. Robson read a paper dealing with smoke in Bengal, describing the action taken to prevent undue emission. A special smoke commission was appointed, and it was stated that, since 1906, 90·8 per cent. of the smoke from factory chimneys had been abolished—a remarkable achievement. In an evening address on the same day Sir John Robertson, Medical Officer of Health of Birmingham, emphasised the injury done by smoke in obstructing the sun's rays, more particularly the ultra-violet. This affects children especially, and results in a failure to deposit lime salts in the bones and teeth, thus causing rickets and dental decay. It was stated that the exposure of rickety children to sunlight is an almost certain cure if the disease has not progressed too far.

In the conference Dr. Fishenden gave a general summary of the position relative to the low temperature carbonisation problem, and the general trend of the discussion showed that the real difficulties in producing a low temperature coke, suitable for domestic use, are financial and economic rather than technical. Nothing new or of outstanding interest was brought forward in connexion with the industrial side of the smoke problem, but there was a general agreement that the real reason why industrial smoke still remains a serious evil in Great Britain is not any technical impossibility in preventing it, but rather the absence of any special effort to do so on the part of many manufacturers.

On the domestic and housing side of the conference there were several interesting papers—one by Mr. E. D. Simon and Miss Marion Fitzgerald. This gave valuable statistics of the steps taken in different places in connexion with new housing schemes. The Ministry of Health was criticised somewhat severely for "totally ignoring" the recommendation in the Interim Report of the Departmental Committee on Smoke Abatement that "the central housing authority should decline to sanction any housing scheme submitted by a local authority or public utility society unless specific provision is made in the plans for the adoption of smokeless methods for supplying the required heat." This criticism was afterwards replied to by Mr. Poynton-Taylor, chief assistant architect of the Ministry of

Health, who endeavoured to show that they had done as much as they could.

A paper by Messrs. R. Unwin and Poynton-Taylor, chief and chief assistant architects respectively of the Ministry of Health, dealt with the problem of the domestic fire and set out the methods at present available. In the discussion on this there was an expression of opinion against the 'all-electric' house as a possible solution of the smoke problem, owing to the high cost of electricity and the absence of the ventilating effect with electric heaters. Messrs. Unwin and Taylor described the theory of 'zoning,' whereby the factories in a new town should be located outside the town, and on that side where the prevailing wind would blow the smoke away from the living quarters. Dr. Owens criticised the soundness of this principle, suggesting that it is the light anti-cyclonic, rather than the strong turbulent south-west, prevailing wind which should govern the position of factories; concentration and low drift of smoke are characteristic of the former, while dilution—owing to high velocity and turbulence—with the latter makes smoke of less consequence. He therefore suggested that factories should be so situated that the light easterly anti-cyclonic wind does not blow smoke over the living quarters.

Dr. Leonard Hill gave to the conference a paper on ventilation and heating, in which he stated that the most healthful form of heating is by a bright, visible source. He said, "We want, then, an elastic system of heating, not plenum or stove heating with windows all sealed up, but a fire which can be made up or let down, and an open window." Radiant heat and cold air are his ideals of healthful heating

The chief interest in the conference centred round the domestic heating problem and the need for a cheap, smokeless, solid fuel which, apart from ordinary gas coke, is not available in sufficient quantity at present to help materially. Probably the most valuable effect of the conference was to keep before the public the importance of smoke abatement rather than any specific contribution towards the solution of the problem

University and Educational Intelligence.

CAMBRIDGE.—The commemoration of the tercentenary of the death of Francis Bacon will take place on October 5. The University is conferring honorary degrees upon Sir Ernest Rutherford and Prof. William Holdsworth. A reception at Trinity College will be followed by a lecture upon Bacon, by Dr. C. D. Broad. In the evening, Trinity College will entertain a number of guests to dinner.

AN interesting programme of lectures has been arranged by the British Institute of Philosophical Studies for the forthcoming session, beginning October 4. In the Michaelmas term the Hon. Bertrand Russell will give two courses of lectures: (1) on the problems of philosophy, (2) on mind and matter. Dr. T. W. Mitchell will deliver ten lectures on medical psychology. Prof. G. Dawes Hicks will deliver ten lectures on the development of philosophy since Kant. A course on general psychology, by Prof. C. W. Valentine, should appeal to a wide audience. In the Lent term Dr. C. Delisle Burns will lecture on the philosophy of social life, and Prof. J. S. Mackenzie on social values. The Very Rev. Dean Inge, Dean of St. Paul's, has promised to give a course of six lectures on the philosophy of religion, in the Summer term. A full syllabus of lectures can be obtained on application to the director of the Institute, 88 Kingsway, W.C.2.

Contemporary Birthdays.

September 21, 1867. Rt. Hon. Lord Bledisloe, K.B.E.
September 23, 1850. Prof. W. Mitchinson Hicks, F.R.S.
September 23, 1863. Mr. William Lutley Sclater.
September 23, 1850. Prof. Richard von Hertwig.
September 25, 1843. Dr. Thomas C. Chamberlin.
September 25, 1866. Prof. Thomas H. Morgan, For. Mem. R.S.

Lord BLEDISLOE was educated at Sherborne and Eton, graduating at University College, Oxford. Until lately he was chairman of the Lawes Agricultural Trust Managing Committee. In 1922, at the Hull meeting of the British Association, he was president of Section M (Agriculture), delivering an informing, if pessimistic, address on efficient organisation in agriculture and the means of its development. Lord Bledisloe is now Parliamentary Secretary to the Ministry of Agriculture and Deputy Minister of Fisheries.

Prof. HICKS, born at Launceston, was educated at Devonport, graduating 7th wrangler at St. John's College, Cambridge. He was principal of and professor of physics in the University of Sheffield from 1883 until 1905. At the Ipswich meeting of the British Association in 1895 he was president of Section A (Mathematics and Physics). The Royal Society awarded a Royal medal to Prof. Hicks in 1912 for his contributions to hydrodynamics and those on vortex motion. He is Hon. D.Sc., Victoria.

Mr. SCLATER, bearer of a name much honoured in the scientific annals of a past generation, was educated at Winchester and Keble College, Oxford. He was a science master at Eton College, 1891–95; afterwards director of the South African Museum, Cape Town, from 1896 until 1906.

Prof. RICHARD VON HERTWIG, distinguished as a zoologist, emeritus professor of zoology and comparative anatomy in the University of Munich, and director of the Zoological Institute, was born at Friedberg, Hesse. He has specially studied the Radiolaria and the Rhizopoda, whilst he contributed two monographs on the Actiniaria to the reports of the *Challenger* Expedition. Prof. Hertwig is Hon. Sc.D., Cambridge, and a foreign member of the Linnean Society.

Dr. CHAMBERLIN, the veteran geologist, was born at Mattoon, Illinois, U.S.A. He graduated at the University of Michigan. Professor of natural science in the State Normal School, Whitewater, Wisconsin, 1867–1872, he held afterwards the chair of geology in Beloit College from 1873 until 1882, transferring then to a similar chair in the University of Chicago, retiring in 1919. Dr. Chamberlin has rendered valuable geological service to the State of Wisconsin. He acted as geologist in the Peary Relief Expedition of 1894. He is a foreign member of the Geological Society.

Prof. T. H. MORGAN, occupant, since 1904, of the chair of experimental zoology in Columbia University, N.Y., was born at Lexington, Kentucky. He was educated at the State College of Kentucky and Johns Hopkins University. Prof. Morgan is a foreign member of the Royal Society. In 1924 the Society awarded him its Darwin medal for his researches in biological evolution, variation, and inheritance. He is the author of "The Mechanism of Mendelian Heredity" (1915) and "The Physical Basis of Heredity" (1919).

provision should at the same time be made for the scientific study of all those factors on which good administration and material development depend."

After these assurances it is disappointing to find that the Committee, out of the total of 10,000,000*l.*, recommends the allocation of 8,949,536*l.* for railways, ports, roads, and waterways, and allocates only 39,000*l.* for research: namely, 4000*l.* for the Amani Institute, 5000*l.* for the Geological Survey in Tanganyika, and 30,000*l.* for a Northern Rhodesia Research Station at Mazabuka. Applications were submitted for larger sums, including 100,000*l.* by the Government of Kenya Colony for research in native welfare, 50,000*l.* by the same colony for a Veterinary Institute at Kabete, near Nairobi, 5000*l.* for the continuance of the Veterinary Laboratory at Mpapwa, and by the Uganda Government for a grant, amount unspecified, for a Sleeping Sickness Station at Entebbe. These research schemes are either so nebulous or so likely to overlap with other work that the Loan Committee is unable to recommend them without fuller information.

The Committee suggests that 1,000,000*l.* out of the loan should be allotted to roads, waterways, and research; and as out of that amount 547,872*l.* is not yet allocated, the balance appears to offer adequate funds if suitable definite research work is proposed. How much is likely to be used for research is doubtful. Of the 452,000*l.* of which the allocation has already been recommended by the Committee, only 8·6 per cent. is for research; and as the Committee has not included in its recommendations anything for road construction in Kenya, Uganda, or Nyasaland, and has invited alternative proposals for the large grant applied for under this head by Kenya Colony, the expenditure on research under this loan may be quite inadequate.

In regard to the Amani Institute for agricultural research, Sir George Schuster's committee proposes a policy which the Secretary of State states definitely in the preface that " he does not accept." Apparently he intends to appoint a Director and trust him to develop a plan for the work, organisation, and relation of the Institute to the technical departments in the East African territories. The Committee doubts the wisdom of this policy, which is certainly speculative, as its success depends entirely on the selection of a suitable man for an ill-defined post. The Committee recommends that a small commission of the best scientific experts available should determine the scope of the work to be undertaken there. If it should then be found impossible to provide the Institute with the necessary funds, the Committee considers that " it would be better to face the facts and close the institute altogether rather than to attempt to run it with an inadequate and second-class staff."

Either the closing of the Amani Institute or its second-rate maintenance would be a national disgrace as well as a calamity to East Africa. The Institute was established when the locality was in German East Africa; it was planned on magnificent lines, was well equipped, and had in progress work of primary importance. Sir Frederick Lugard's appreciation of the former merits of Amani doubtless inspired his excellent suggestion during the recent discussion at the British Association on African race problems, that it would be an appropriate gesture in the development of Tanganyika Territory to re-appoint some of the former staff. Sir George Schuster's Committee doubts whether a first-rate scientific expert would be willing to accept the directorship of Amani until the future of the Institute be assured. Men considering the appointment might fear the fate of the former Geological Survey of Tanganyika Territory, where the Director would not agree to the Governor setting aside the method of work which had been agreed to when he accepted the appointment. It would appear difficult to select the right man for the post until the scope of the work to be undertaken at Amani has been defined. An appointment on the lines at present contemplated might follow the too common precedent of selecting as director a man of administrative experience and engaging scientific experts to work under him.

That scientific research should develop on economic and sound lines, the Committee recommends the establishment of a sub-committee under the Committee of Civil Research to consider the foundation of " an Imperial organisation of scientific research, with the object of securing the best possible co-ordination of effort throughout the Empire and of deriving full value from all existing organisations." Any scheme for the extension and better co-ordination of research throughout the British Empire is to be welcomed; but the sub-committee proposed would not serve the urgent needs of British East Africa and would not render unnecessary a special organisation for these territories. The duty proposed for the new sub-committee would, moreover, so far as concerns the scientific development of the economic resources of the Empire overseas, overlap with the Imperial Institute, which was established for that purpose. If that Institute is unable to fulfil its functions, it should be made able: it has a large building and a considerable endowment, and there seems no reason to expect a sub-committee of the Civil Research Committee to be more successful. The insistence by Sir George Schuster's committee that the different British East African territories should co-operate, and that each should specialise in the work for which it has the best

opportunities, is unquestionably sound: and it is not the fault of that committee that it has only been able to recommend for research the meagre pittance of less than 0·4 per cent. of the loan. The proposals received were too indefinite. A sub-committee of the Civil Research Committee appears to be the most easily constituted authority to secure a prompt decision as to the research needs of East Africa; and if the sub-committee were successful with those territories, its efforts to secure co-operation and prevent duplication of work might secure for it the wider function with which the Loan Committee would overburden it at the start.

The Theory of the Gene.

The Theory of the Gene. By Prof. Thomas Hunt Morgan. (Yale University: Mrs. Hepsa Ely Silliman Memorial Lectures.) Pp. xvi + 343. (New Haven, Conn.: Yale University Press; London: Oxford University Press, 1926.) 18*s.* net.

IN this volume is published the series of lectures on the Silliman Foundation recently given by Prof. Morgan. We are not told when the lectures were delivered, but as the book appeared only during the present year, we may take it as representing the latest pronouncement of the American school of geneticists on these matters. In the first chapter is given a formal statement of the theory of the gene, and in view of the fact that some misconception of what it implies is not infrequently to be found among biologists who have not specially studied genetics, it may be as well to reproduce it here.

"The theory states that the characters of the individual are referable to paired elements (genes) in the germinal material that are held together in a definite number of linkage groups; it states that the members of each pair of genes separate when the germ-cells mature in accordance with Mendel's first law, and in consequence each germ-cell comes to contain one set only; it states that the members belonging to different linkage groups assort independently in accordance with Mendel's second law; it states that an orderly interchange—crossing-over—also takes place, at times, between the elements in corresponding linkage groups; and it states that the frequency of crossing-over furnishes evidence of the linear order of the elements in each linkage group and of the relative position of the elements with respect to each other."

It will be noticed that nothing is stated about the chromosomes; though if the linear order of the elements in each linkage group be accepted, and it is clearly the simplest explanation of the facts as they stand, then the interpretation in terms of chromosomes follows almost as a matter of course. Still, the omission is significant, conveying as it does the recognition of the fact that even if the chromosomal interpretation were ultimately to be rejected, the phenomena of segregation and of linkage, the foundations of the theory of the gene, would remain unaltered. At present, however, there are few signs of weakness in the chromosomal interpretation, and in his chapter on "Chromosomes and Genes" Morgan brings forward fresh evidence from Drosophila in demonstration of its strength.

As might be expected, the fruit fly is much to the fore in this volume, though less so than in Morgan's earlier books on "The Mechanism of Mendelian Heredity" and "The Physical Basis of Heredity." Nevertheless, in the chapters on the "Origins of Mutant Characters," on "Chromosomes and Genes," and on "Genes in Related Species," it figures prominently, owing to the unrivalled material which it offers for discussion. The brief chapter giving a comparative account of the operation and arrangement of the genes in several closely allied species of Drosophila is one of the most interesting in the book, and might well have been expanded. Geneticists will look forward with keen interest to the progress of this work, offering as it does one of the most fruitful lines of attack on the problem of species.

Another chapter of much interest is that in which the author discusses the well-known "Presence and Absence" hypothesis. This generalised view of the relation between dominant and recessive characters has never found favour with the American school, and Morgan devotes many pages and much ingenuity in arguing against it. Some of his cases will certainly not bear the strain he puts upon them. For example, the argument that the 'albino' guinea pig cannot be due to absence of the pigment producing gene, because it often has a few coloured hairs on the feet and toes, at once falls to the ground when it is realised that such animals are not true albinos at all, but very slightly pigmented forms analogous to the Himalayan rabbit. So too the objection that the recessive black rabbit actually has more pigment than the dominant wild grey type at once loses its force when it is understood that the question at issue is not of the grade of pigmentation but of a definite inhibitor for pigment. That this is the proper way of looking at it is clear from Onslow's striking research on the chemical nature of this very case. Again, Morgan argues that since there is a dominant white in poultry, there must, on the Presence and Absence hypothesis, exist an inhibitor for this white factor in the wild jungle fowl. The argument supposes that all domestic breeds are descended from *Gallus bankiva*, but in the light of recent work this is almost certainly not true. As a matter of fact, Morgan admits that it is very difficult

to present any clear-cut evidence against the Presence and Absence hypothesis in contradistinction to the existence of positive recessive genes. In the end he falls back upon the familiar argument from multiple allelomorphs, and here we need not follow him; for if the reader will turn to Bateson's paper on "Segregation," which was recently published in the *Journal of Genetics*, he will realise that this group of phenomena, so often adduced against the Presence and Absence hypothesis, may quite well be regarded as one of its chief supports.

Still, the implications involved in the Presence and Absence hypothesis are of such fundamental importance to the science of genetics, and the difficulty of obtaining decisive evidence between the rival hypotheses is so great, that we may be pardoned for commenting upon a case which seems to provide the best evidence of the kind yet obtained. This is the interesting case of the 'bar-eye' in Drosophila to which Morgan has devoted several pages of his book (pp. 86-91). Experiment has shown that when females homozygous for the dominant bar gene (B) are crossed with the recessive normal male, they produce occasional normal sons. Sturtevant demonstrated that this is due to the fact that in the homozygous barred female an irregular process of crossing-over occasionally occurs which results in one of the X chromosomes carrying both of the bar genes while its mate is left without one. The occasional normal male alluded to above is produced when the gamete carrying the X chromosome that has lost its B is fertilised by the Y chromosome gamete of the male. Now since the X chromosome lacking B has been brought to this state through crossing-over with one that also contains B, it cannot contain that positive recessive gene for normal eye postulated by the American school. In other words, it can contain *nothing* from the bar locus. Yet in association with a Y chromosome which also contains *nothing* it gives rise to the normal eye. Hence the appearance of the normal eye must be due to the *absence* of B, and not to a positive recessive gene corresponding to bar. This is surely as good a demonstration of the validity of the Presence and Absence hypothesis as we can hope to obtain.

Nearly one-third of the book is devoted to an account of forms in which the chromosomes depart from the normal diploid arrangement, whether through the loss of a set as in haploids, or through duplication as in triploids, tetraploids, and polyploids, or else through loss or addition of individual chromosomes as in heteroploids. The author has made use of the interesting material that has recently accumulated in wheats and other plants, and especially in Datura through the remarkable researches of Blakeslee and Belling, and has produced an account which will be at once useful and stimulating to the student. There is rather a lack of synthetical grip in the account, but perhaps this is hardly to be expected when dealing with a branch of study where most of the facts are the outcome of the past few years only, and into which they are so rapidly pouring.

Another third of the book is devoted to the subject of sex considered in its relation to the chromosomes. The outstanding problem here is still the relation between the two groups into which diœcious animals fall, namely, that in which it is the male sex that is heterogametic (the XX-XY type) and that in which it is the female sex that is so constituted (the WZ-ZZ type). Seeing that both types may occur in the same class of animals, as for example in vertebrates, and also in insects, it is difficult to suppose that they will not eventually be harmonised under some common scheme. Morgan inclines to the view that the chromosomes involved in the two types are not homologous, but that the two types have arisen independently through some change in balance. It is not very clear how such a change might be supposed to have come about, and we could have welcomed more discussion on this most important point.

In this portion of the book devoted to sex the reader will find some account of intersexes and of sex-reversal, upon which so much interesting work has been done in recent years. The facts are often accompanied by shrewd bits of criticism which will be of great value to the student, but here again one has the feeling that the author tends to lose grip as he proceeds. The impression conveyed is that of a collection of facts, of the highest interest and fairly set forth, but insufficiently digested, inadequately related to one another. The book as a whole lacks that unity found in Prof. Morgan's other books dealing with heredity—the unity that comes from a thorough assimilation of the facts. We cannot help the suspicion that the author's hand was forced by his appointment as Silliman lecturer, and that if he had had his own way he would have preferred to wait a little longer before writing it. In making such a criticism we do not wish to imply any condemnation of the book. Every geneticist should read it and be grateful to Prof. Morgan. But, judged by the high standard that we have become accustomed to expect from him, we are naturally rather disappointed when he tends to fall below it.

In conclusion, we would direct attention to some errors in the hope that they may be set right when a further edition is called for. On p. 113 a drawing is described as "a periclinal chimaera, S. lycopersicum." It is true that it represents *S. lycopersicum*, but *S.*

lycopersicum is *not* a periclinal chimæra. On p. 175, last line but one, "Fig. 12" should surely read "Fig. 33." On p. 247 the figure of the embryo calves has been so drawn as to omit the direct vascular connexion which was the main point of Lillie's original picture. In the note on p. 265, Crew is quoted as having fertilised the eggs of a hermaphrodite frog with its own sperm. Reference to the original will show that this hermaphrodite only functioned as a male in fertilising the eggs of a normal female. The 'common' cabbage butterfly is a Pieris, not a Colias as given on p. 293. In Figs. 11 and 12 the rules should be arranged as in Fig. 13. In neither case does the male shown on the second line belong to the F_1 generation, nor does the third line represent an F_2 generation as indicated.

One further point may be mentioned in connexion with the bibliography at the end of the book. This runs to some 26 pages and contains numbers of titles to which no reference is made in the text. Yet in the text some 40 papers are quoted for which no reference is given in the bibliography. It is extremely aggravating to the student to find a reference to a paper that he does not know, and to turn to the bibliography to find that it has been omitted; nor is there any consolation in finding the titles of a hundred other papers with which he is already familiar.

R. C. PUNNETT.

Optics—Pure and Applied.

(1) *The Principles of Physical Optics: an Historical and Philosophical Treatment.* By Ernst Mach. Translated by Dr. John S. Anderson and Dr. A. F. A. Young. Pp. xi + 324 + 10 plates. (London: Methuen and Co., Ltd., 1926.) 21s. net.

(2) *Handbuch der biologischen Arbeitsmethoden.* Herausgegeben von Prof. Dr. Emil Abderhalden. Lieferung 187. Abt. 2: *Physikalische Methoden*, Teil 2, Heft 1. *Das Interferometer, seine Anwendung zur Untersuchung von Gasen und Flüssigkeiten*, von Paul Hirsch; *Ultramikroskopie*, von Marie Anna Schirmann; *Refraktometrie*, von Heinrich Kessler. Pp. 737-906. (Berlin und Wien: Urban und Schwarzenberg, 1926.) 7·50 gold marks.

(1) A CERTAIN philosopher once said, "Learn the past, so that you may know the future"; but history appeals very differently to different minds; one sees in it a subject satisfying in itself, while to another the past is dead save in so far as it yields lessons for present and coming days. Prof. Ernst Mach's "Principles of Physical Optics" is bound to make a wide appeal to the many who cannot find much time to go back to the original authors of optical theory and practice, though it must be noted that the matters treated do not extend to the more contentious topics of the present day, such as the nature of light, the problem of the ether, the quantum theory, and so on; they are confined to those older parts of the subject which are adequately treated on the basis of the undulatory theory of light.

It is a common experience that first-hand reference to original books and papers is invaluable. The early investigator was treading a new path, and the subject was developing in his mind in a spontaneous and natural manner. His very mistakes are instructive. The modern text-book, on the other hand, is apt to be written by a much less ingenuous author, who returns to the elementary parts of the theory with a subconscious contempt for, and lack of appreciation of, the difficulties which beset the path of the beginner. Then, again, there are the writers who fail dismally through never having thoroughly mastered the elementary principles of their subjects. On the other hand, an adequate acquaintance with even the works of the main optical writers, Newton, Huygens, Young, Fresnel, and the rest, is a matter for years. Hence the appearance of the book under review will be welcomed, because from its perusal it is possible to obtain a clear idea of the historical development of the subject and of the contributions of the various early thinkers.

It is not a book for the beginner. For such, nothing can take the place of a careful systematic treatment adapted to develop the philosophical sense which is demanded of the reader of the present volume. From its very nature, an historical treatment must deal with matters with which a beginner need not concern himself, such as Newton's "theory of fits." Then, again, the standard of knowledge demanded of the reader of Chapter ii. (on the rectilinear propagation of light) is certainly higher than that of a novice; and the same applies to the several later parts of the book. Nevertheless, it is a valuable book for a teacher or for a student who wishes to get a little beneath the surface of the subject.

The translators have performed their task well, although there are a few places in which the meaning is obscure. The text is full of interest, and the admirable range of portraits gives a human touch to all.

It seems to the writer that one or two references to recent work might well have been added by the translators. For example, the following passage occurs in the description of the Michelson interferometer: "If it is desired to study an interposed substance which is non-homogenous, and upon which the eye must thus accommodate, parallel light cannot be used for this purpose, and the substance may not be traversed *twice* by the rays." Such a statement, although perhaps applicable to the case in

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question, should not have been passed without a reference to Twyman's modification of the instrument, in which the interposed substances *are* traversed twice by the 'parallel' rays. There is still an unfortunate gap between the optics of the laboratory and the workshop, and there are several places where this is instanced in the present work.

Prof. Mach occasionally manifests an amusing touch of dogmatism. His introductory letter speaks of "the only possible form of immortality." Has he, then, explored the possibilities of life so thoroughly? Dogmatism emerges, too, in the discussion of colour vision. The conclusive nature of the introspective analysis of a series of sensations is taken for granted, and Thomas Young is accused of introducing confusion into the subject! It is to be hoped that this statement may challenge some to go back to Young's own discussion. In another case where a psychological question is involved, namely, the question of light quantities, the book is vague and unsatisfactory. The coming of physical photometry is foreshadowed in terms which give no hint of the many and serious difficulties which have been encountered since 1913, when the German edition of the book was published. Indeed, the statements on p. 20 would lead the unsuspecting to conclude that a physical measurement of the gross energy of "the *illuminating* rays" (whatever that may mean) is an adequate means of finding the "quantity of light emitted from a light source in unit time." We conclude with regret that the 'philosophy' of the book is lamentably lacking where it might be most helpful. This is yet another instance of a clear call for the insertion of a translator's note directing attention to more recent developments. It is not forgotten that the book deals with physical optics, but every text-book ought to indicate the vital points of connexion between its own subject and allied branches of knowledge.

A feature of the book which deserves especial praise is its treatment of polarisation and double refraction. For several years past, the present writer has encouraged optics students to begin the study of these subjects with the simplest apparatus and natural crystals, such as were available to the early workers. In this way they obtain a thorough acquaintance with the main features of the subject; after a day or two of making retardation plates of mica, and using natural crystals of quartz, they are ready to appreciate the quartz wedge; the natural rhomb of spar affords an introduction to the Nicol prism and its modifications. Thus by easy stages the properties of uniaxial crystals become familiar; and how many students are *really* ready to pass beyond this stage in the limited time of college courses? The book adopts a similar method of approach, and, in addition, describes many beautiful experiments which will be new to the majority of readers.

This book, then, may be commended to all teachers who have occasion, in the midst of the multiplicity of subjects comprised in present-day 'physics,' to give some little attention to 'light.'

(2) This volume is a part only of one of the series of 'Handbooks' with which German scientific literature is so extensively equipped. The present section has articles dealing with (*a*) interference refractometers for gases and liquids, by Paul Hirsch; (*b*) ultra-microscopy, by Marie Anna Schirmann; (*c*) refractometry, by Heinrich Kessler. The object of the whole handbook is to explain to biologists the various physical, chemical, psychological, and other experimental methods employed in biological practice; the discussion of the physical instruments is very elementary and non-mathematical; almost unnecessarily so, in fact. Nevertheless, the practical details are well described, such as the determination of the constituents of serum by the use of the interferometer for liquids. The portable gas-interferometer, which has found a use in detecting fire-damp in coal mines, is described.

The section on ultra-microscopy begins with an exposition of the Abbe theory of microscopic resolution, where the author apparently gets mixed with her two equations, then passes on to a good description of the different methods of 'dark-ground' work, and the methods of Siedentopf and Zsigmondy. The fault of these handbooks is that they are apt to give an undue confidence in their completeness. No mention is made of recent British dark-ground condensers of the focussing type. Nothing becomes out-of-date quite so rapidly as the highly technical handbook.

The section on refractometry appears to be reasonably complete so far as German apparatus and methods go, and there is an abundance of practical detail likely to be of use to the chemist or biologist. The differential method of Hallwachs is described by way of conclusion.

L. C. MARTIN.

Direct Realism.

A Theory of Direct Realism: and the Relation of Realism to Idealism. By Dr. J. E. Turner. (Library of Philosophy.) Pp. 324. (London: George Allen and Unwin, Ltd.; New York: The Macmillan Co., 1925.) 12*s.* 6*d.* net.

THIS book is the outcome of a bold and engaging enterprise. It sets out to do two things; first (and chiefly) to cut a clean way through the tangled growth of modern epistemology by justifying the plain man's view that the perceiving mind is in immediate contact with the external world, "as this actually

exists," or that ordinary sense-perception, so far as it goes, "is, in principle, veridical"; secondly, to show that Hegelian idealism is entirely compatible with this supposedly antagonistic realist view.

The second aim is well fulfilled. The last four chapters of the book give a good and well-documented version of what idealism meant for Hegel, and on lines that are not now unfamiliar, pretty completely demolish the charge of subjectivism that for long lay at Hegel's door. But the first part of the book is less satisfactory. One can imagine the sigh of relief that would go up if Dr. Turner or any one else thoroughly established the position which he wants to hold. For 'phenomenalism,' as Dr. Turner sees, is a nuisance to scientific workers and to philosophers alike: and we should all be glad to be persuaded out of it. The trouble is that whenever one starts to reflect upon the process of perception, the extreme complexity of that process drives one obstinately to the conclusion that only by ignoring many plain facts and making some gallant but unverifiable assumptions, is it possible to hold that (to use the simplest terms) 'the-thing-as-it-is-perceived' is 'the-thing-as-it-really-is.' Yet that is what Dr. Turner aims at showing—in his own words, "the existential identity between sensed contents and physical entities" (p. 23).

Dr. Turner's main point is that most of the difficulties have arisen because modern analysis has started its work too far up. It begins with and remains within mature adult experience where the distinction between 'appearance' and 'reality' is already entrenched. If, however, we start at a more primitive and simple level of apprehension, we find it free from that embarrassment, since all sensed contents are there taken as '*inherently* existent.' Standing on this ground, therefore, and carrying forward from it, under the guidance of this realised unity, the analysis of perceptual processes, Dr. Turner concludes that it is possible to regard "the entire series of physical and physiological processes as determining, not the actual existence nor real character of the object of perception, but simply *perception itself* as being also a process, but of a higher order than these preliminary basal processes" (p. 160).

The result is disappointing. For even if one grants the validity of the argument by which this thesis is supported, it is hard to see why it should be held to dispose of all the difficulties which have led to phenomenalism, or to justify the desired conclusion that perception is in principle veridical. Yet it is proper to say that in some of the detail of his argument Dr. Turner breaks new ground in an interesting and hopeful way. His discussion of imagery, for example, is acute and good; and if his review of the "causational aspects of perception" will scarcely bear all the weight which he lays upon it, it is nevertheless fresh and valuable.

It must be added that the first section of the book is sadly ill-arranged. Dr. Turner has gone to enormous trouble to make himself acquainted with the views of all important recent writers on realist epistemology. Unhappily, the very fullness of his knowledge prevents his allowing his own story to tell itself. It has to be gathered largely from his criticism of others—often enough on points of no great material importance. It is a pity that Dr. Turner did not take down his scaffolding. He has written a good book, which might easily have been much better.

Our Bookshelf

(1) *Modern Views on Digestion and Gastric Disease.* By Prof. Hugh MacLean. (Modern Medical Monographs.) Pp. x + 170 + 20 plates. (London: Constable and Co., Ltd., 1925.) 12*s.* net.

(2) *Modern Methods of Feeding in Infancy and Childhood.* By Donald Paterson and J. Forest Smith. (Modern Medical Monographs.) Pp. ix + 106. (London: Constable and Co., Ltd., 1926.) 7*s.* 6*d.* net.

THE value of the "Modern Medical Monographs" edited by Prof. Hugh MacLean has already been indicated in these columns. We now welcome the appearance of two additions to the series.

(1) "Modern Views on Digestion and Gastric Disease" is the contribution of the editor of these monographs. Its object is to provide a general account of the physiology of digestion and to indicate the main principles in the treatment of gastric disorders. The early chapters summarise the process of digestion, and include references to the more recent methods of gastric investigation, such as the fractional test-meal. The author emphasises the importance of recognising as a normal feature of digestion the existence of regurgitation from duodenum to stomach, which until recently was looked upon as an abnormal occurrence. The greater part of the book is devoted to the consideration of the main gastric diseases and their diagnosis. Perhaps the most controversial section is that dealing with the etiology of gastric carcinoma. Prof. MacLean records considerable evidence to refute the teaching of many pathologists and surgeons that this condition is often preceded by ulcer. The observations on the great differences in duration of symptoms of gastric ulcer and gastric cancer suggest very strongly that malignancy arising in an ulcer is rare. The section on treatment indicates the importance of basing therapy on physiological knowledge. The book is well illustrated by radiograms, and will be of great assistance to student and physician in the study and treatment of gastric disease.

(2) "Modern Methods of Feeding in Infancy and Childhood." An understanding of this subject is as necessary to the general practitioner as a sound knowledge of digestive disturbance in adult life. Dr. Paterson and Dr. Forest Smith urge the importance of insisting on breast-feeding wherever possible. The difficulties which may arise in connexion with this are

discussed and various methods of artificial feeding are indicated. A number of diet tables are given, covering the period of childhood up to the age of five. If the physician will remember the authors' reiterated maxim that feeding must be varied to suit the individual, he will find this book a very useful guide in an important branch of his practice.

Surveying. By Dr. W. Norman Thomas. Second edition. Pp. viii + 548. (London: E. Arnold and Co., 1926.) 25*s.* net.

THIS second edition differs but little from its predecessor. A few more corrections, a revised section on air survey (or "aerial survey" as the author calls it), and an appendix on pivotal errors in theodolites constitute the changes. The book is written for students of civil engineering. Naturally, therefore, it is a text-book on engineering rather than on topographical surveying, and it lacks the practical hints, and models of computation, which should be included for the latter purpose. The civil engineer will, however, find in it a clear explanation of all the methods he is likely to employ. Unlike many authors of works on surveying, Mr. Norman Thomas is at pains to examine the precision of each method he describes. He does so with conspicuous success, and illustrates his mathematics by examples drawn, in the main, from surveys in Great Britain and in the Empire.

There are one or two odd points in the author's sequence. He refers to maps in the chapter on chain surveying, and none of those referred to save those published by the Ordnance Survey were made with the chain. Again, to most of us surveyors, triangulation is the usual preliminary and the most useful friend. It comes late in the book, and when it comes this chapter does not stress sufficiently the importance, in any type of survey, of the theodolite. British theodolite design is diminishing the lead which some continental manufacturers have been allowed to acquire. It is a pity, then, that in his note on "Recent Developments in the Construction of Surveying Instruments" (included in the appendix on pivotal "Errors in Theodolites") some mention of new theodolites has not been made. Nowadays, when labour and transport are so heavy an item, it is more than ever important to get the best of instruments and to economise in time and weight. These, however, are small points, and every surveyor will be well advised to get and study this volume.

An Introduction to Practical Biology: a Course of Work based chiefly upon the Plant and arranged for Use without Special Apparatus in either the Class-room or the Home. By Norman Walker. Pp. viii + 224. (London: Sir Isaac Pitman and Sons, Ltd., 1926.) 5*s.* net.

ONE of the hindrances to the more frequent introduction of science subjects into the schemes of study under the tutorial class movement has been the difficulty of arranging for the practical work necessary to supplement the theoretical side, if the subject is to be at all successfully taught. Dr. Walker, who has had a long experience of the tutorial class movement in the north of England and has a wide knowledge of the needs and difficulties of adult students of this kind, has outlined a series of practical exercises illustrating some of the elementary principles of biology which can be carried out in the class-room or the home, without any special or elaborate apparatus and at a comparatively trifling cost. The work is based chiefly on plants, but certain exercises involving the use of animals are included. The student is guided, in clear and simple language, through a series of experiments and observations on the structure, physiology, and chemistry of plants and animals, sexuality and fertilisation, inheritance and variation, while the implication of such knowledge on the problems of human society is not overlooked.

The book is admirably conceived and meets a distinct need. It is becoming increasingly necessary that some knowledge of biological principles should form part of the educational equipment of all men and women. Dr. Walker's book shows how this can be acquired in a simple and inexpensive manner, and points the way to a wide dissemination of such knowledge through the medium of tutorial classes for adult students.

A Monograph of the British Lichens: a Descriptive Catalogue of the Species in the Department of Botany, British Museum. Part 2. Second edition revised. By Annie Lorrain Smith. Pp. ix + 447 + 63 plates. (London: British Museum (Natural History), 1926.) 20*s.*

A SECOND edition of Part 2 of the well-known "Monograph of the British Lichens," published by the British Museum, has just appeared. Part 1 of the first edition was prepared by Crombie and published in 1894. Part 2, elaborated by Miss A. Lorrain Smith, was published in 1911. Miss Lorrain Smith then proceeded to the difficult but useful task of revising part 1 (1918): she has now laid lichenologists under a further debt of gratitude by revising and bringing up-to-date her own volume, part 2. She states in an introductory note that there are no fundamental changes in the new edition, though the addition of many species, some rearrangement of genera and species, and other alterations will be noted. Only those who have worked at the small saxicolous lichens can fully appreciate the time, care, and patience which are required in describing and naming this group of organisms. British lichenologists are singularly fortunate in having a flora thoroughly up-to-date, and by an authority such as the author, provided in the excellent series of monographs published by the British Museum.

Hydrology and Ground Water: a Practical Text-Book for the Use of Civil Engineers, Surveyors, Students, and all those who deal with the Control of Water. By J. M. Lacey. Pp. viii + 159. (London: Crosby Lockwood and Son, 1926.) 12*s.* 6*d.* net.

WITHIN about a hundred and fifty pages the author has attempted to condense a treatment of the various phenomena associated with rainfall and ground water. Naturally the treatment is summary in places. The earlier chapters on rainfall, especially the sections on cycles of rainfall, are least satisfactory, and would require to be expanded if the volume were to be of general value. But it is planned chiefly to meet the needs of the water engineer, and for this purpose it is certainly well arranged, clear, and useful. The chapters on wells and water storage are of particular value.

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

On the Oxygen Spectral Line $\lambda = 5577{\cdot}35$ Å.U.

A NUMBER of investigators, including Merton, Barratt, Johnson, Cameron and others, have shown that the spectrum of an element in the gaseous state can be profoundly modified if an electric discharge be passed through it when one or other of the rare gases helium, neon, argon is mixed in excess with it.

For example, Merton and Pilley showed that by this method it is possible to enhance greatly the arc spectrum of atomic nitrogen and even to isolate it completely from the spark spectrum of this element.

Again, it was shown a year ago by McLennan and Shrum that a line of weak intensity existed at λ 5577·35 Å.U. in the spectrum of oxygen, and that this line could be considerably strengthened when helium or neon were added in excess to oxygen excited by the passage of an electric discharge through it

As McLennan and Shrum put forward the view that this line in the spectrum of oxygen is identical with the famous "green line" λ 5577 Å.U. observed in the spectrum of the light from the night sky, and in the spectrum of the aurora, we were led to engage during the past year in a rather exhaustive study of the main characteristics of the line. The results of this investigation will be given in detail elsewhere, but in the meantime we think it well to state here a few results that are of special interest now.

(1) The spectral line λ 5577 Å.U. has been shown to be obtainable with pure oxygen and with intensity the strongest when the gas is at a pressure of two millimetres of mercury and the exciting electrical discharge is passed through a tube about one metre long and three centimetres in diameter.

(2) When currents varying in strength up to 160 milliamperes were used, the intensity of the line steadily increased with the strength of the exciting electrical current.

(3) A new series of measurements has shown that the wavelength of this spectral line is very close to λ 5577·35 Å.U.

(4) This spectral line, λ 5577·35 Å.U. has never been observed in our experiments in the spectrum of any electrical discharge in the absence of oxygen.

(5) When an electrical discharge was passed through oxygen at a pressure of 2 mm. of mercury mixed with helium, the line was obtained with strongest intensity when the partial pressure of the helium was about 20 mm. of mercury.

(6) A series of carefully executed experiments has shown that the power possessed by the rare gases of enhancing the oxygen line λ 5577·35 Å.U., assuming the strength of the line in oxygen alone to be 1, is as follows: helium 1·7, neon 4·6, argon 84·2.

(7) When argon in excess was mixed with oxygen the line λ 5577·35 Å.U. was obtained with an intensity greater than that of any known line in the spectrum of atomic oxygen having a wavelength shorter than λ 6000 Å.U.

(8) Observations with a powerful echelon spectrograph showed that the oxygen line λ 5577·35 Å.U. is simple and without any fine structure.

(9) In studying the Zeeman effect with the line λ 5577·35 Å.U. it was found that magnetic fields of weak to moderate intensity produced a symmetrical broadening of the line, the magnitude and the character of this broadening being of the order and of the nature respectively of that usually shown by spectral lines having an atomic origin.

(10) It would appear that this spectral line λ 5577·35 Å.U. originates in an electron transition between atomic levels for oxygen provided by one or other of two new singlet-triplet schemes that were based on Hund's theory and were recently put forward (*Proc. Roy. Soc.*, July 1926) by McLennan, Grayson Smith and McLay.

J. C. MCLENNAN
J. H. MCLEOD (Student of National Research Council of Canada).
W. C. MCQUARRIE.

The Physical Laboratory,
University of Toronto,
September 1.

Interference and Corpuscular Light.

IN the new wave theory of matter (Einstein, L. de Broglie, Schrödinger), the material point is conceived as a singularity in a wave. More precisely, in the absence of any field of force, the wave phenomenon called 'material point' is represented by a sinusoïdal solution of the equation:

$$\Delta u - \frac{1}{c^2}\frac{\partial^2 u}{\partial t^2} = \frac{4\pi^2}{h^2} m_0{}^2 c^4 u, \quad . \quad . \quad (1)$$

where m_0 is a constant characteristic of the wave (proper mass of the material point). The function u has a uniformly moving singularity which *is* the material point. If the point at rest has a spherical symmetry, then the solution of (1) will be (the line of motion being chosen as z axis)

$$u = \frac{A}{\sqrt{x^2 + y^2 + \dfrac{(z - vt)^2}{1 - v^2/c^2}}} \sin 2\pi\nu\left[t - \frac{vz}{c^2}\right].$$

Further, the energy of the moving point is identical with the product $h\nu$.

In the special case of the light quant, we must suppose m_0 to be equal to an extremely small quantity if not to zero. Then the wave equation (1) reduces to the classical form:

$$\Delta u = \frac{1}{c^2}\frac{\partial^2 u}{\partial t^2}. \quad . \quad . \quad . \quad (1')$$

For each problem of interference or diffraction, classical optics tries to find a solution of the form:

$$u = a(x, y, z)e^{2\pi i\nu[t - \phi(x, y, z)]}, \quad . \quad . \quad (2)$$

satisfying the adapted limiting conditions. But, for the new mechanics, the motion of the light quants is given by a solution of (1′) of the form:

$$u = f(x, y, z, t)e^{2\pi i\nu[t - \phi(x, y, z)]}, \quad . \quad . \quad (3)$$

where the amplitude f has many moving singularities. The function ϕ is to be the same in (2) and (3), and the singularities, *i.e.* the light quants, must describe the curves normal to the surfaces ϕ = Constant.[1] In substituting (2) and (3) in (1′), we get the two following relations connecting the classical amplitude a and the 'granulated' amplitude f, respectively, with the phase-function ϕ:

$$\frac{2}{a}\frac{\partial a}{\partial n} - \frac{1}{a^2}\frac{\partial(a^2)}{\partial n} = -\frac{\Delta\phi}{\partial\phi/\partial n}, \quad . \quad . \quad (4)$$

$$\frac{\partial\phi}{\partial n}\cdot\frac{\partial f}{\partial n} + \tfrac{1}{2}f\Delta\phi = -\frac{1}{c^2}\frac{\partial f}{\partial t}, \quad (5)$$

dn being an element of trajectory.

[1] Of course it remains to prove the existence of such a solution of equation 1′ in each case.

Now, by analogy with the solution for the free spherical material point, we can suppose that the quantity $f/(df/dn)$ is zero at the points occupied by the light quants at a given instant. Then the velocity of a quant in passing by a point M will be, for example, 5:

$$v_M = \left(- \frac{\partial f/\partial t}{\partial f/\partial n} \right)_M = c^2 \frac{\partial \phi}{\partial n}. \quad . \quad . \quad (6)$$

The motion of the quants is permanent and $-c^2\phi$ plays the part of a velocity potential.

But, during the motion, the number of quants remains constant and along a very thin tube of trajectories, we must have:

$$\rho \sigma v = \text{constant}, \quad . \quad . \quad . \quad (7)$$

where ρ is the mean density of light quants in the wave and σ the section of the tube.

Hence, we conclude that:

$$\frac{1}{\rho}\frac{\partial \rho}{\partial n} + \frac{1}{v}\frac{\partial v}{\partial n} + \frac{1}{\sigma}\frac{\partial \sigma}{\partial n} \quad (8)$$

But infinitesimal geometry teaches us that the last term of the first member is equal to twice the mean curvature of the phase surface. Thus, equation (8) gives easily:

$$\frac{1}{\rho}\frac{\partial \rho}{\partial n} = - \frac{\Delta \phi}{\partial \phi/\partial n}, \quad . \quad . \quad . \quad (9)$$

and by comparing (9) and (4) we see that:

$$\rho = c \, . \, a^2. \quad . \quad . \quad . \quad . \quad (10)$$

The density of light quants is to be taken proportional to the classical intensity. In the dark fringes of the classical theory, the density of quants will be zero, but in a bright fringe a great number of quants will pass. Now, the motion being permanent, this explanation of the experimental facts will still be available if the light is very weak (Taylor's experiment), we have only to define the density of quants by a time average instead of a space average.

LOUIS DE BROGLIE.

Paris, August 27.

Science and Psychical Research.

I HAVE read the editorial note appended to the letters on this subject published in NATURE of September 11, and desiring to keep within the limits that you wish to be observed in this discussion, I have tried strictly to confine myself in the following remarks to replying to allegations against myself made by Sir Arthur Conan Doyle in that issue, as also to the specific points raised by Dr. Tillyard in his rejoinder to my letter on this subject published in NATURE of August 28.

Sir Arthur Conan Doyle states that my account of the incidents connected with the Combermere photograph, published in the issue of August 28 "is both inaccurate and misleading." It will, I think, be sufficient to direct attention to one only of Sir Arthur Conan Doyle's statements, to show whether he is, or I am, the more accurate person. After telling how I challenged him to publish, in the *Morning Post*, the ghost photograph alongside a photograph of the peer taken in life, Sir Arthur Conan Doyle goes on to say (italics are mine) —" I at once sent up my photograph *without any suggestion whatever that it would not reproduce*. That statement is a pure invention on the part of Mr. Campbell Swinton."

In reply to this, may I quote the opening sentence of Sir Arthur Conan Doyle's letter to the Editor of the *Morning Post*, published in that paper on April 23? It is as follows:

" I beg to enclose the Combermere photograph. I am advised that it will not reproduce, but you will be the best judge of that."

These two entirely contradictory statements, both from the pen of Sir Arthur Conan Doyle, show how little reliance can be placed upon the accuracy of what he writes, and I therefore do not propose to make any further reference to the remarks contained in his letter to NATURE except to say that they consist of a tissue of misrepresentation, together with a number of statements which are no more accurate than the one quoted above.

With regard to Dr. Tillyard's rejoinder, I should like, first of all, to say how much I appreciate the spirit in which he has accepted what may have seemed to him my somewhat provocative criticisms. I must, however, further criticise what he now says.

Dr. Tillyard complains that I do not distinguish between spiritualism and psychical research; but, so far as I can see, the only distinction between the two is that the second includes the first, while I may add that, though the heading under which it appeared was "Science and Psychical Research," Dr. Tillyard's article purported to be a review of a "History of Spiritualism."

Nowhere have I ever suggested that the medium is one of the experimenters, as Dr. Tillyard surmises. On the other hand, I cannot agree with him that the medium is a mere instrument, such as a microscope or spectroscope, for, quite apart from the question of free will, which is probably an illusion, due to the same portion of the brain being concerned in determining both our wishes and our actions, human beings have consciousness and motives, which are things possessed by no man-made instrument or mechanism.

Dr. Tillyard states, "If a medium is found to be fraudulent, then the genuine psychical researcher will not proceed with him, but will endeavour to find a more trustworthy one." But this, anyway, was not the method adopted by Crookes, who, I suppose Dr. Tillyard will agree, was one of the greatest of psychical researchers. If we are to believe the authorised life of Sir William Crookes, written by Dr. Fournier d'Albe, "Crookes does not seem to have taken up the medium (Miss Cook) seriously until after she had been exposed by a Mr. Volckman, who seized 'Katie King' (supposed to be a spirit) and found himself holding the medium (Miss Cook) dressed up."

Furthermore, Miss Cook, who had by then married and become Mrs. Corner, was again exposed by seizure, when masquerading as a spirit, by Sir George Sitwell, the well-known baronet. A detailed account of this exposure will be found under the heading "Capture of a Spirit" in the *Times* of Jan. 12, 1880, while in the *Times* for Jan. 15 following, there is a letter from the secretary of the British Association of Spiritualists (on whose premises the seance was held), on behalf of the council of that body, stating that Sir George Sitwell's account of what occurred was substantially correct. Sir George Sitwell quite recently told me that this complete exposure, which had wide publicity, made so great a sensation that it nearly wrecked the whole spiritualistic movement of that time; so Crookes must have known all about it. Yet, a few years later, as recorded in Sir Arthur Conan Doyle's history, we find Crookes giving an unqualified testimonial as to the bona fide mediumship of this twice-convicted impostor.

All scientific men hold Crookes in the highest veneration both as a physicist and as a chemist, but what can they think of his judgment in respect to spiritualistic matters, having regard to what is disclosed above?

Dr. Tillyard mentions the names of Crookes and of four other scientific men who studied spiritualistic

phenomena, and then asks me whether I can name a single one of these who did not become convinced of their genuineness. Surely this is a case of begging the question, as these are the particular five who did become convinced; but what about the others? What about Faraday, Tyndall, Sir David Brewster, and Dr. Carpenter, among those who are dead, and Prof. R. W. Wood of the U.S.A., Sir E. Ray Lankester, and Sir Bryan Donkin among those who are living? All these and many others have, I believe, made sufficiently serious investigations into the subject, though naturally, having come to the conclusion that there was nothing genuine in the phenomena warranting further research, they did not publish so much as other no more eminent, though perhaps more credulous investigators.

It may also be mentioned that, in 1908, a committee, including such eminent photographic experts as R. Child Bayley, F. J. Mortimer, and E. Sanger-Shepherd, though assisted by such a well-known spiritualist as Mr. A. P. Sinnett and others, failed to secure proof that spirit photography is possible.

Dr. Tillyard suggests that I should visit the National Laboratory for Psychical Research, but I must confess that I am not attracted by its name, which with its suggestion of parallelism with the National Physical Laboratory, seems to me to be *suggestio falsi*. I am informed that it is a purely private concern, with nothing national about it whatever. Apart from this, however, in my opinion thermographic phenomena in connexion with mediums are more a matter for a physiologist than for a physicist. That emotional disturbances affect the temperature of the body is, I think, fairly well known, and there does not seem to me to be any reason for dragging in such supernormal and incredible phenomena as the production of ectoplasm and such like in order to explain what are only commonplace matters. But then, all psychical researchers seem to delight in the maxim *omne ignotum pro magnifico*.

A. A. CAMPBELL SWINTON

40 Chester Square, London, S.W.1,
September 10.

The Structure of the Continents.

As all the continental discussions of the observations of near earthquakes have been carried out by graphical methods, and as I could not satisfy myself as to the precision obtainable by these methods, I have recently carried out a rediscussion of the principal series of data by the method of least squares. These refer to the Kulpa valley earthquake of 1909, the Wurtemberg one of 1911, the Tauern earthquake of 1923, and the Oppau explosion. The results indicate very definitely that there is an upper layer that transmits compressional waves with a velocity of 5·6 km./sec. (though a velocity of 5·4 km./sec. would fit the Oppau explosion slightly better) and a lower one where the velocity is 7·8 km./sec. In addition, the Tauern earthquake gave rise to a wave with a velocity of 6·2 km./sec., which must have travelled in an intermediate layer. The probable error of all these velocities does not exceed 0·1 km./sec. The result for the upper layer corresponds to that found for granite by E. D. Williamson and L. H. Adams. The recent work of L. H. Adams and R. E. Gibson gives a velocity of 6·4 km./sec. in basaltic glass, and of 8·4 km./sec. in dunite, at ordinary temperatures and at pressures corresponding to depths of some tens of kilometres. If we allow for the higher temperatures within the crust, the basaltic layer below the granite may be in a glassy state, as Daly has suggested, and the lower layer may well be dunite. The evidence indicates that there is no further sudden change to a depth of about 1200 km.

The times of arrival of all the waves were linear functions of the epicentral distance; the consistency of the observations was great enough to give good determinations of the gradients of these functions, and hence of the velocities, but it was not enough to establish any departure from linearity. Hence there was no material for a determination of the depths of the foci or of the variation of velocity with depth in the various layers. By combining the results for near quakes with those for distant ones, however, it was possible to estimate the rate of increase of velocity with depth in the lower layer.

The observations permit a rough determination of the depths of the granitic and basaltic layers. The former may be about 12 km., the latter about 20 km., but both are subject to an accidental error of about 4 km. In addition there is a possibility of systematic error. Uncertainty as to the depth of focus may allow the thickness of the granitic layer to be doubled. On the other hand, the movement on the seismogram due to the indirect waves starts more gradually than that due to the direct one, and this may cause a slight delay in their measured time of arrival, especially as most of the observations seem to have been made on instruments recording on smoked paper. On this ground the depths determined may require some reduction.

I think, therefore, that determinations of the depths of the layers by means of near earthquakes are not more reliable than those based on the earth's thermal state, isostatic balance between continents and oceans, and the group-velocities of surface waves. All of these are affected by uncertainty concerning the thickness of the basaltic layer, but the uncertainties of the method based on the compressional waves from near earthquakes appear more serious. The results, taken as a whole, are as consistent as can be expected; a thickness of 10 to 15 km. for each layer would be within the range of uncertainty of every method.

HAROLD JEFFREYS.

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Curved Path of Wireless Waves.

IN a recent number of the *Proceedings of the Royal Society* (Series A, vol. 111, N.S. 757) there appears under the title of "Discussion on the Electrical State of the Upper Air," a paper giving the views of several of the authorities who have contributed to the examination of this subject.

The discussion really turns on the question as to why wireless waves follow the curvature of the earth instead of spreading into space.

Heaviside supposed that this was due to a hypothetical conducting layer of the atmosphere existing at a great altitude above the earth's surface, which would act as a reflecting barrier and would compel the wave to remain within the envelope formed by it. Only one contributor to the discussion referred to refraction and diffraction as possible causes.

If it were assumed that the speed of long waves is the same as that of ordinary light, and depends in the same way on the density of the air, then refraction would account for, roughly, one-tenth of the observed deflection. I believe, however, that there are no direct measures of the velocity of long waves, and there is no sufficient knowledge of the nature of the 'ether' or of its relation to ponderable matter to allow of any certain, or even probable, theoretical deductions on this point.

As regards the velocity of visible light in air, the shorter the wave-length the less the velocity, but if it is true that X-rays are only shorter but otherwise similar waves, then since it is found that their refractive index for all substances through which they can pass is practically unity, there must be, at and after a certain shortness of wave-length is reached, a condition in which a decrease of wave-length is accompanied by an increase in velocity.

At the other end of the spectrum (where wireless wave-lengths are reckoned in miles) it seems not impossible that there may be a drop in velocity as the wave-length increases, although at present a physical explanation may be wanting.

A case of diminished velocity with increased period would occur in air if the waves were of such great length that the heat due to compression had time to diffuse. For such waves the velocity would tend to approach that given by Newton.

If it were found that for 'wireless' waves the velocity increased about one part in four thousand (the velocity of light is scarcely known to this degree of accuracy) per mile of height above the ground, the reason for such waves following the curvature of the earth would require no further explanation, and until experiment proves that there is no such change, it would be reasonable to impute the observed curvature of path to this kind of cause.

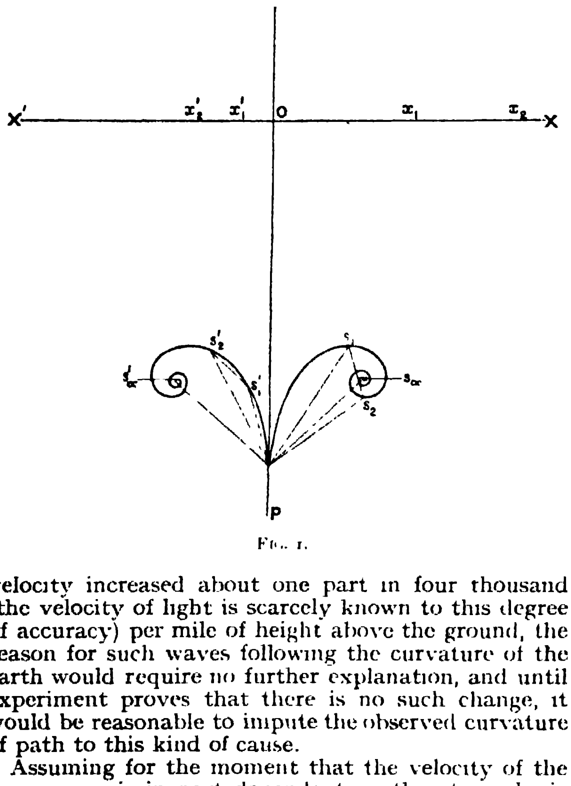

FIG. 1.

Assuming for the moment that the velocity of the long waves is in part dependent on the atmospheric conditions and increases with the elevation, it is certain that it will vary at different parts of the earth's surface, and this being so, the variation in the intensity and direction of trains of long waves would be only a leisurely analogue of the 'twinkling' of the stars.

Diffraction would have a slight effect in favour of increasing the audibility of signals when the observing station was within the 'shadow' of an obstruction, but this would only be noticeable for distances which were small fractions of the earth's radius. Diffraction would also cause variations of intensity at different levels above the boundary of the shadow, but it is unlikely that these 'bands' could be recognised without some instrumental aid in comparing intensities.

Nearly fifty years ago I gave [1] a graphical construction for determining diffraction effects, which as it was not published and is of very general application, I reproduce below.

Let it be required to know the intensity of the light at a given point in the normal to a wave surface.

For simplicity let the problem be one in two dimensions, and the wave surface be a line $X'OX$ (Fig. 1) emitting co-phasic waves confined to the plane of the paper. It is required to know the intensity at P due to all the partial waves emanating from $X'OX$.

Starting from P draw the curves S and S', such that the elements of arc at S and S' are proportional to the amplitude at P of the waves received from the elements dx and dx' at x and x', and also that the angle which the tangents at S and S' make with the normal OP, are the differences in phase in which the partial waves from x and x' reach P from the corresponding phase of the wave from O. Then the square of the chords PS and PS' are proportional to the intensity of the light which reaches P from either side of the normal between the limits x and x', and the total intensity at P is the square of the resultant of PS and PS' and the phase is given by the angle which the resultant makes with OP.

If x and x' are both infinite the intensity is given by $2PS^2_\alpha$, and the phase is the same as that which reaches P from O.

If $x = \alpha$ and $x' = 0$ the intensity is PS^2_α, and the phase differs from that of the wave from O by $\pi/4$. (This is the intensity at the edge of the geometrical shadow of O.)

If the source of illumination consists of disconnected portions of the line XOX', lying, say, between the limits x_1x_2, x_3x_4, etc., the resulting intensity at P due to each portion will be given by the squares of the chords s_1s_2. s_3s_4, etc., and the square of the resultant of these chords will give the total intensity.

The formal proof of this construction is simple and need not occupy space here.

I have recently been told that a somewhat similar construction was given by Cornu, but this I have not seen.

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Exeter.

[1] This was in a Report to the Royal Society on the ruling of diffraction gratings, and on the variation of the intensities of the different orders of spectra as affected by the form of the cross section of the grooves.

Schroedinger's Quantum Theory and the Stark Effect.

THE theory of atomic oscillations recently advanced by Schroedinger is of extraordinary importance since it throws a new light on the problems of atomic structure and, at the same time, offers a convenient practical method for calculating the Heisenberg-Born intensity matrices. It seemed desirable to apply it to as many special cases as possible. A complete theory of the Stark effect in hydrogen was, therefore, developed.

The first order effect (displacement of lines proportional to the first power of the electric field) turned out to be identical with that obtained by the writer on the basis of Bohr's theory (*Ann. d. Phys.*, 50, 489, 1916). The second order effect (displacement proportional to the square of the field) differs slightly from the expression found in the old theory by the writer (*Ann. d. Phys.*, 51, 184, 1916) and independently by Mr. Mosharrafa (*Phil. Mag.*, 46, 753, 1923). The dependence of this term on the three quantic numbers n_1, n_2, n_3 is expressed in the new theory by

$$-(n_1+n_2+n_3)^4\{17(n_1+n_2+n_3)^2-3(n_1-n_2)^2 -9n_3^2+18n_3+10\},$$

while in the old theory the terms $18n_3+10$ were

absent. Messrs. Takamine and Kokubu found a slight second order displacement of the central components of the H_γ line in a field of 130 kilovolts. Both formulæ give for this displacement practically the same value of 0·3 Å.U. in the right direction (while the absolute value of 0·3 Å.U. seems of the right order of magnitude, but somewhat smaller than the observed shift), so that the additional terms do not permit us to distinguish in favour of either theory.

Most interesting are the new intensity formulæ—comparatively simple closed expressions. It is known that in the old theory the correspondence principle was not sufficient to account for the intensities completely and that certain orbits ($n_3=0$) had to be eliminated by a special ruling prohibiting the electron from falling into the nucleus. Such a dualism is not necessary in the new theory; the state $n_3=0$ simply does not occur, and there is no need of any artificial restriction. So far, only the intensities of the *p*-components have been calculated. Comparing the calculated values with Stark's observations, the writer found the same situation which was stated by H. N. Russel in his work on intensities of multiplets (NATURE, 115, 835, 1925). The values estimated by observers agree, not with the calculated intensities, but with their square roots, *i.e.* with the absolute values of the amplitudes. Allowing for this, the agreement is fair, as appears from the following tables:

H_α line.			H_β line.		
Z.	Obs.	Calc. Ampl.	Z.	Obs.	Calc. Ampl.
2	1	0·8	0	1·4	0
3	1·1	1·1	2	1·2	1·8
4	1·2	1·3	6	4·8	4·8
			8	9·1	8·3
			10	11·5	9·9

H_δ line.			H_γ line.		
0	0	0	2	1·6	1·6
4	1	0·8	5	1·5	1·7
8	1·2	0·8	8	1	1
12	1·5	1·7	12	2·0	2·2
16	1·2	1·2	15	7·2	6·2
24	2·8	6·1	18	10·8	9·8
28	7·2	6·7			

We can say that the new theory based on Schroedinger's ideas accounts for the Stark effect at least as well as the old one.

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July 24

Atomic Volumes of Carbon and Hydrogen.

PROF. INGOLD has introduced an important modification of Baeyer's strain theory, which brings the calculated ring strains into closer agreement with the thermal data of the cycloparaffins and with the general chemistry of the formation and decomposition of this series of saturated hydrocarbons (*Trans. Chem. Soc.*, 119, 305, 1921). He has pointed out that the carbon atoms in a cycloparaffin are secondary and, by assuming that the carbon atoms attached to the central one occupy more of the surrounding space than the two hydrogen atoms, has calculated the angle (115 3°) between the carbon to carbon valencies from the atomic volumes of carbon and hydrogen.

Objection may, however, be taken both to the method of calculation and to the values (Traube's) employed for the atomic volumes. In deducing the equation for the angle it is assumed that the two spheres representing the attached carbon atoms and the two spheres representing the hydrogen atoms are in mutual contact. This assumes either that the central carbon atom has a very much smaller volume than the carbon atoms united with it, or that the domains of the atoms are far from mutually exclusive. Neither of these assumptions appears to be in harmony with the main thesis that the value of the angle is determined by the volumes of the attached groups. It is possible, having determined the angle by this arrangement, to allow the small internal carbon sphere to assume its normal size without altering the angle, but, since the four attached spheres would then be moved through unequal distances, it is difficult to see how the arrangement then obtained depends directly on the volumes of the surrounding atoms.

Now the two spheres representing the attached carbon atoms and those representing two hydrogen atoms may be placed in contact with a sphere, representing the central carbon atom, in such a way that the inner tangents from the centre of the central sphere to each pair of adjacent spheres (in the plane through their centres) make equal angles. In such an arrangement allowance for the different atomic volumes of carbon and hydrogen is made directly, and, if the atomic volumes of carbon and hydrogen are taken as 4 : 1, it can be shown that the angle of the carbon to carbon valencies is 116° 34′. It would appear from recent investigations that the ratio 4 : 1 is a better measure of the atomic volumes which Prof. Ingold employed.

W. F. SHORT.
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June 21.

A Glaciated Ochreous Flint from Cromer.

DURING a recent visit to Cromer I found upon the foreshore site there, a flint of pyramidal form, and typical ochreous colouration. The more or less flat base of the pyramid is extensively glaciated (Fig 1),

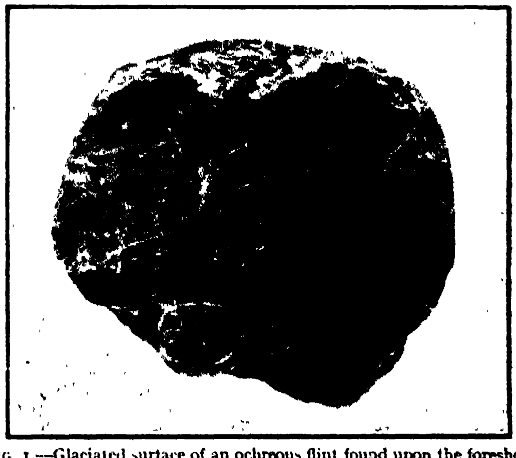

FIG. 1.—Glaciated surface of an ochreous flint found upon the foreshore site at Cromer. Half natural size.

and the striæ were obviously imposed after the flint was patinated. The ochreous specimens from Cromer are, as a rule, remarkably free from striation, but it is evident that this particular flint was exposed to the effects of moving ice—possibly of the second glacial epoch of East Anglia. In any case the specimen is, without doubt, glaciated, and its discovery affords final proof of the great antiquity of the ochreous flints found upon the Cromer foreshore.

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Psychological Aspects of Our Penal System.[1]

By Dr. JAMES DREVER.

THE root idea in punishment as ordinarily understood is the infliction of some kind of disagreeableness, pain, or loss on an individual, because he has been guilty of some misdeed. There are thus two aspects—on one hand the infliction of hurt, on the other hand the relation of this to some wrongdoing or crime. Originally any end to be gained by such infliction was scarcely conscious, if it existed at all—any end, that is to say, beyond the satisfaction of the anger evoked by the misdeed itself. The psychological source is to be found in the anger caused by the wrong. From this primitive source to the modern conception the evolution of theories of punishment, conscious or unconscious, may be said to have passed through four stages or phases. These may be designated the vindictive, the retributive, the protective or deterrent, and the reformatory or curative.

To begin with, an individual who has suffered injury by the wrongdoing of another responds to the injury with the emotion and impulse of anger. This is satisfied by the infliction of some hurt on the wrongdoer. At the simplest and crudest stage of development—the stage where we have to deal with the mere instinctive impulse of the brute or the savage the hurt inflicted on the wrongdoer may have no direct relation, either in kind or in degree, to the injury done, but only to the intensity of the anger evoked. Of course this is not really punishment in any strict sense. Nevertheless it is unquestionably the psychological origin, and it therefore marks the first stage in the evolution of what became punishment in the strict sense. This is the vindictive stage or phase. In so far as punishment at any time reveals the same emotion and impulse it represents this primitive vindictive stage.

Even in a very primitive social life, however, some crude notion of justice must very early act as a determining influence on the hurt that may be inflicted on another for some injury done. So far as some notion of justice is a conscious determinant of the hurt inflicted on the wrongdoer by the injured individual, this hurt takes on the character of retribution, and punishment as such comes into being. This phase or stage in the evolution of punishment is the retributive phase or stage.

Another factor must have made its influence felt in a rudimentary way at a comparatively early stage. The notion of punishment must have involved a looking forward as well as backward, in the shape at least of a dim feeling that similar actions to that which has incurred it must be prevented in the future. There can be little doubt, that is to say, that at a comparatively early stage primitive society must have felt vaguely that punishment had a protective function, since by means of punishment of a culprit the individual and society were protecting themselves against the repetition of an injurious act.

The general line of evolution of our modern penal systems is thus clear. First of all we have purely vindictive action on the part of the injured individual. Then there is some sort of legalising—if we may use that word—of retributive action on the part of the injured, so long as this retributive action does not go beyond the limits of 'justice,' this being regulated by social law. Finally, recognising that punishment has a protective function as far as social life is concerned, society itself takes over the infliction of punishment, and a penal system is inaugurated. This stage or phase is the protective or deterrent stage or phase.

[1] From the presidential address to Section J (Psychology) of the British Association, delivered at Oxford on August 6.

EVOLUTION OF A PENAL SYSTEM.

To leave the matter thus, however, would be to obscure important aspects and phases of the actual course of events, and could not fail to produce a misleading impression of the facts. Stages in social evolution are never clear-cut. Thus the development of the retributive view of punishment by no means involved the discontinuance in practice of vindictive punishment. Still less did the realisation of protection as the primary social function of punishment alter the practice which had been founded on the older and more primitive conceptions. Practice lagged a long way behind theory in this, as in so many other cases.

The psychological explanation of the actual facts would appear to be that the crude emotion of anger remained the driving force behind punishment, though it was cloaked and obscured by other motives, and by various forms of rationalisation. After all, the reaction of anger is a natural reaction to an act which society agrees in reprobating. One leading authority on criminal law has indeed placed on record his conviction that it is "highly desirable that criminals should be hated, that the punishments inflicted upon them should be so contrived as to give expression to that hatred, and to justify it so far as the public provision of means for expressing and gratifying a healthy natural sentiment can justify and encourage it." I am afraid the learned author's thoughts have become somewhat mixed up in the latter portion of this statement. It sounds as if his rationalisation were not very satisfactory, even to himself.

However that may be, it is certain that the realisation by society in theory that the function of punishment from the point of view of society was primarily protective did not prevent an almost religious sanction continuing to be attached to the *lex talionis*. This remained, in fact, an assumption at the base of all penal systems which no one seriously challenged; and it is equally certain that the protective function of punishment was frequently made the excuse, as in the writer just quoted, for continuing the practice of vindictive punishment—'for deterrent purposes' was the usual rationalisation—even when it was quite evident that the psychological situation thus produced was often inimical to the ends sought. One need only instance the brutalising influence of capital punishment on society at large, and its inevitable tendency to increase the frequency of the crime of murder, during the period when it was the punishment also for less serious crimes, to show the kind of psychological situation which was created. Curiously enough the more humane—and indeed saner—attitude and practice of modern times in civilised countries were

due far less to recognition of the fact that vindictive punishment for deterrent purposes was frequently an entire failure, than to the fact that the infliction of pain and suffering on human beings became objectionable to the general sense of society.

The phase or stage of evolution at which we have now arrived is characterised, on one hand, by the discontinuance, or the radical limitation, of what was virtually the primitive vindictive punishment in disguise, and on the other hand by the recognition of social punishments as possibly possessing a reformatory or curative function. We may speak, therefore, of the present phase or stage as the reformatory phase or stage in the evolution of social punishment. The actual situation, however, is somewhat complex. Practically punishment still rests, in law and in popular thought, on the retributive basis—the *lex talionis*. Theoretically it is recognised that from the point of view of society punishment is protective, and this is its primary function, and also, I believe, that society is not directly concerned with the retributive aspect of punishment as such, but only indirectly because of the deterrent effect of retributive punishment. Moreover —and this is the mark of the phase of evolution at which we have arrived—it is realised that, so far as the individual is concerned, social punishment may be made reformatory, and that the reformatory function of punishment is worth keeping in view, if only because reformation of the individual means protection of society against the repetition of the injury so far as that individual is concerned, always provided that the attempt to reform the criminal does not involve the sacrifice of the primary aim.

PUNISHMENT OR REFORMATION?

The psychological problems of social punishment fall into two groups: on one hand those involved in the effects of punishment on the individual who is punished, and on the other hand those connected with the effects of punishment on the community itself. Of course there is a repercussion on society of the effects on the individual, so that the problems of punishment are ultimately in every case social problems. Nevertheless, we shall find it convenient to consider the two groups of problems separately in the meantime.

Consider first the problems arising in connexion with the effects of punishment on the individual who is punished. So long as the retributive aspect of punishment is placed in the foreground, the only psychological problems of serious import are those involved in the question of the responsibility of the offender. This question of responsibility is one over which medical and legal minds have long been at loggerheads. The source of this age-old controversy between lawyer and medical man lies primarily in the fact that the two use the word 'responsibility' in entirely different senses. For the lawyer 'responsibility' is purely a legal term, and the question of responsibility is to be determined on the basis of evidence germane to its legal meaning. For the medical man 'responsibility' is an ethical term, and the question of responsibility therefore raises much wider issues.

The psychological problems involved in the legal definition of responsibility are, more especially in so far as the question of control is raised, extremely difficult. I do not believe, however, that responsibility in this sense is a practical issue at all in connexion with any penal system. At least it does not arise in the form in which it is usually raised, or at the point at which it is usually raised, in a practical consideration of the problems of punishment as affecting the individual who has infringed social laws.

It is when we emphasise the protective and particularly the reformatory aspects of punishment that the vital psychological problems emerge. So far as we base our practice in social punishments upon these two functions, it is not too much to say that our whole practice must be guided primarily by the outcome of psychological inquiry. The two functions are not in conflict. We may aim at the protection of society by the reform of the delinquent. Treatment which is successful in eliminating a particular tendency to delinquency in an individual will *ipso facto* protect the community against the repetition of this delinquency by the same individual. Of course it will not necessarily protect society against the same form of delinquency in another individual. That is why we have to consider punishment, rather than reformation pure and simple, and that is why the silly and sickly sentimentality which regards the wrongdoer as a suffering victim rather than a criminal will always fail to appeal to any one, no matter how soft-hearted, who regards the whole situation frankly and sanely.

It is obvious also that the failure of reformatory measures must not be taken to imply the failure of society to protect itself. Other measures must be available, which are merely protective, and not at all, or only indirectly, reformatory. On the other hand, it is clear that reformation is, as a rule, the more economical way to secure protection for the community, provided there is reasonable hope of success, and so long as we restrict our attention to the individual delinquent. The reform of the delinquent is doubly a social gain. From being a minus quantity with respect to social efficiency he becomes a plus quantity. This point is especially important in the case of the juvenile delinquent.

Punishment exerts its influence through disagreeableness, or the fear of disagreeableness. The function normally performed by unpleasantness encountered in the activity of any living organism is to guide the activity so that unpleasantness may in future be avoided. The fear of unpleasantness again checks the immediacy of impulse, and so allows time for a new kind of behaviour to be substituted for the old kind which led to unpleasantness—the beginnings in the case of the human being, it is worth noting, of self-control. But it is only low down the scale of organic life that the phenomena are to be seen in their simplicity. As we pass up the scale the inner conditions which determine behaviour become more and more complex, and the actual results of any unpleasantness or fear become more and more difficult to foretell. With the human being the complexity of the inner situation has become enormous. The web of impulse and motive is so intricately and so subtly interwoven that the introduction of a new impulse and motive may come to have a result wholly unforeseen and entirely different from the result intended.

PRACTICAL DIFFICULTIES.

The most important source of practical difficulty is frequently our almost complete ignorance of the inner conditions which issue in any particular misdemeanour. This necessarily involves ignorance of the effect which our punishment is likely to produce. So far as the reformatory aspect of punishment is concerned, this is a very serious matter. We have to deal with an individual, and we must know the facts of that individual case. Any psychologist who has had experience of conflict cases among juvenile delinquents, can easily find illustrations from his experience. The usual form of misdemeanour that occurs is stealing, and frequently irrational and apparently motiveless stealing. Thus money, jewellery, and all kinds of things may be stolen and given away, or even thrown away. Until the inner conditions are understood and the causes of the trouble removed, no kind of treatment seems to be of any avail. Or sometimes, where punishment is apparently successful in eliminating the tendency to one particular kind of misdemeanour, there is a criminal outbreak in a totally different direction, the result of the punishment itself, which more than counterbalances any apparent success.

Cases of this kind tend to make one speak and think of treatment rather than punishment. It might be asked whether this is not the point of view from which all cases should be approached, not as a matter of ethics, but as a matter of practical expediency, punishment being merely a particular method of treatment. The proposition is arguable, but only so long as we confine attention to the individual delinquent, and that is only one side of the picture, as we shall see presently. Personally, I do not think the point of view will matter very much so long as we keep firmly in mind the essential fact that the action taken, whether we call it treatment or punishment, is primarily action taken by society for its own protection, the reform of the criminal being a means adopted to this end. There is undoubtedly a class of offender in whose case treatment, rather than punishment, is the appropriate notion and procedure. Other cases occur with fair frequency in which punishment as ordinarily understood is quite ineffective as regards the reform of the individual. The case of serious mental defect may be instanced.

The facts are such that we find the old problems of responsibility, so far as they were practical problems at all, cropping up in a new guise, and in new surroundings. It may be possible to determine beforehand, without waiting for the event, whether punishment will be effective for reform, and if so what kind of punishment, or whether the case is one demanding treatment, and not punishment at all, and if so what kind of treatment. The problems now, however, are neither legal nor ethical problems, but purely psychological problems.

The suggestion that in some cases punishment, as ordinarily understood, may be quite ineffective leads us on to the consideration of the measures society takes, and must take, for its own protection in certain instances. The most important method of protection that society utilises is the restraint of the offender in some appropriate institution—so far as the idea of punishment is concerned, some sort of prison. The restraint or imprisonment may be merely temporary, or it may be permanent. In the first case it is clear that the reformatory aspect of punishment ought still to be kept in view, so far as the psychological situation is taken into account. If it is not, it does not require much foresight to prophesy somewhat lamentable results. In particular, if the criminal is returned to social life, not only with his tendency to the original form of misdeed unaffected, but with other anti-social tendencies developed by his prison life, or by circumstances arising out of his prison life, our only possible verdict is that society is playing the fool. On the other hand, when the restraint is permanent, while reformatory measures must not be entirely excluded as intrinsically hopeless in every case, it is clear that the whole psychological situation and outlook are different. The prisoner will never be returned to civil life. For the protection of society he must be kept in restraint permanently. But he is a human being, and the moral sense of society will demand that he be treated as such, not merely negatively by the avoidance of inhuman conditions, but also positively by the provision of such amelioration of his lot as is possible without sacrificing essential principles.

Every one is agreed, I think, as regards these general matters. There will also be general agreement that the stigma of prison life means in itself the very serious modification of the psychological situation in the case of every individual who incurs it, so serious that no psychologist can regard short-term prison sentences with anything but dismay. It must be recognised that it is with respect to prison treatment especially that society, in protecting itself, or attempting to do so, runs the risk of making matters worse instead of better, and the gravest practical problems arise with regard to this type of punishment. Much has been done in recent years to remove acknowledged evils and defects of our prison system. Much may still be done. Nevertheless, I personally, and I imagine most psychologists, would look upon any further advance in the directions hitherto pursued with serious misgivings as to psychological results, until we have first attacked more fundamental problems, and reviewed our whole penal system in the light of the psychological knowledge of to-day.

NEED FOR PSYCHOLOGICAL DATA.

Let me try to indicate where, in my opinion, the crux of the whole matter lies. I think all will agree that the very first essential is that we should have the requisite knowledge and understanding of the psychological situation with which we are faced, and the psychological effects likely to be produced by the action taken. Society has to decide whether an individual delinquent is to be punished in this way or that way, whether he cannot be reformed but must be placed under restraint for life, or can be reformed during temporary restraint by appropriate treatment, or can be reformed without undergoing prison life, and in each case what can and ought to be aimed at. No general theories concerning the causation of crime, no systems of penal philosophy, not even the best intentions in the world, can take the place of a thorough knowledge and understanding of the individual case. This is precisely where our whole penal system is at present most defective. Moreover, the defect is one

that can be remedied without serious difficulty in the present state of development of modern science, medical and psychological, but no opportunity is afforded.

The first and essential step towards the further reform of our penal system lies in affording this opportunity. This could be done by instituting a clinical examination, medical and psychological, of every delinquent before sentence is passed, and by taking advantage wherever possible of modern psychological knowledge. The psychological clinic is at present practically non-existent in Great Britain. It is high time this state of matters was remedied. School and law-court both demand its institution. That is the first step. When we have taken that step, we shall be able to take further steps in penal reform with the advantage of acting with adequate knowledge of what can be done, and what we are really doing in each particular case. Until that step is taken, every other change we introduce by way of reform has a hit or miss character, which cannot fail to be profoundly disturbing to any thoughtful student of social development.

It may be objected that we are in danger of losing sight of the fact that the topic under discussion is punishment, not simply the reformation of the criminal. The suggestion was made above that in certain cases at least it might be more appropriate to speak of treatment than of punishment, the suggestion involving the view that delinquency ought to be looked on as the outcome of something not unlike disease. However that may be, I do not think there is any warrant for excluding either the idea or the fact of punishment, provided we look to the future, and not simply to the past, in our conception of punishment. The action taken against an individual in the form of punishment must involve some disagreeableness or deprivation, and the reason for the punishment is some past act of the individual. But its purpose is the prevention of similar acts in the future. The fact that hitherto we have been discussing the individual aspect only has tended somewhat to obscure this deterrent function, and the consideration of this function will lead us over to the discussion of the social aspect.

The deterrent function of punishment has played no inconsiderable part in the discussion of penal measures at all times. The severity of past penal systems has been largely due—almost entirely so far as it has had a rational basis at all—to the attempt to deter others from similar offences to those for which punishment is inflicted on an offender. It is unquestionably the case that many a misdeed is prevented by the fact that the individual who is tempted knows that he will inevitably pay the penalty, and it is also a well-known fact that, where, through the inefficiency of the police or other cause, punishment is easily evaded, crime shows a corresponding increase.

It cannot be lightly assumed, however, that the deterrent effect of punishment depends merely on fear of the disagreeableness or suffering which the punishment in itself involves. The penal system is an expression, however imperfect, of the sentiments of society with respect to certain acts—sentiments of hatred in varying degrees. It is not the result of a purely intellectual review of the social results and bearing of these acts. Apart, therefore, from the punishment by law decreed and legally inflicted, the criminal act is inhibited, so far as the normal socialised individual is concerned, by this sentiment in himself and in his fellows, how developed we cannot at present stop to consider, but resting ultimately on the primitive anger evoked by injury. "The sentence of the law," to quote again the legal authority already quoted, "is the moral sentiment of the public in relation to any offence what a seal is to hot wax. It converts into a permanent final judgment what might otherwise be a transient sentiment." Fear of the punishment as such, fear of the social disapprobation dependent on the evoking of the moral sentiment, of which the punishment is a concrete and tangible embodiment, recoil from the act because of the existence in the individual who is tempted of the moral sentiment in question in however feeble, attenuated, and fragmentary a form—all these are motives holding back an individual member of society from wrongdoing. The legal punishment exercises its deterrent influence because it, as it were, embodies and presents all of them in unmistakable and arresting fashion. The relative force of the different motives will vary with individuals. But until we can rely on the last of these motives being of itself sufficiently powerful to restrain every individual member of society from the breach of social laws—which would seem to involve a radical change both in the existing social structure and in human nature—the social necessity of some kind of penal system, in the strict sense, must remain.

In conclusion I would revert to the varying motives upon which the deterrent influence of punishment depends. Two points in particular demand notice. In the first place we cannot assume that penal law and moral sentiment will always be in harmony, and so reinforce one another. There may, in fact, be acute conflict between the two, so far as a considerable minority of the members of a community are concerned. In certain cases also they may be, so to speak, indifferent to one another. In either case the psychological situation is very radically modified, and the problems of punishment may in practice become very difficult.

In the second place the influence of the different motives may, as we have seen, vary with the individual. If that be so, two consequences would appear to follow. On one hand—and this refers more particularly to the adult criminal—our penal system must be such as to appeal with sufficient cogency to all the motives, so far as the criminally disposed individual is concerned. On the other hand—and now we have in mind chiefly the juvenile delinquent—it is of capital importance that we should recognise as early as possible in their criminal career those individuals who, either by nature or circumstances, or both, are tending towards abnormality in their reactions to social claims and social penalties. This brings us back to the crux of the whole situation. Means must be provided by which a knowledge of the individual case may be made available, before the decision is taken as to how any offender is to be treated. The temperamentally defective individual may be born, the habitual criminal is largely made. It ought at least to be possible to prevent the making of criminals. Again the glaring defect of our penal system stands revealed. No provision whatever is made for the diagnosis of incipient criminality. It is not merely a case of locking the door after the horse is stolen; it is a case of providing neither lock nor door.

The Use of High Pressures for Steam Turbine Installations.

By STANLEY S. COOK.

THREE different methods are available for the measurement of the performance of a steam engine, and serve that purpose from different points of view according to the particular feature of merit it is desired to emphasise. Thus, from the point of view of the manufacturer whose aim is to produce a turbine of the highest efficiency, that is, one which will convert into useful work the highest possible proportion of the pressure energy that is available in the steam, a figure expressing this proportion appears to meet the requirements of the case. This figure is almost (that is, except for the work of restoring the water of condensation to the boiler) identical with the 'efficiency ratio' as defined by Willans and Sankey in terms of the Rankine cycle, a ratio for many years accepted as the criterion of merit of a steam engine. The user of a turbine, on the other hand, is not so interested in what may be called the intrinsic efficiency of the engine, as in knowing how many pounds of steam per hour he has to generate in his boilers in order to produce a horsepower or kilowatt of output; consequently, a more significant expression of the engine's efficiency from his point of view is the consumption in pounds of steam per horse-power hour, under standard conditions of steam generation.

The latter method of statement of performance has also been commonly adopted, is if anything more familiar than the former and in a sense more practical. Used without qualification, however, it gives the manufacturer of the engine credit for any improvement he may make or find in the vacuum or in the steam conditions, although these are frequently taken into account by means of correction factors which reduce the consumption rate to a standard basis.

It must be recognised, however, that neither of these values supplies the user with the exact information he requires as to the cost of producing a unit of energy. It might easily be found, for example, that as the result of utilising higher pressures or lower vacua the efficiency ratio was reduced, but all the same a better overall result secured as measured in pounds of steam per horsepower, and even actually. At the same time, an improvement in consumption rate by improved steam conditions and improved vacua fails to take into account the increased cost of generating the steam under the new conditions.

A third and more comprehensive method is required to give an adequate measure of the performance of the steam engine as a heat engine. It must be remembered that a turbine is not correctly speaking a heat engine, but only a part of it. The expansion which is carried out in the turbine is only one of the processes in the complete cycle of the heat engine, which consists also of processes of heat rejection, re-compression and heat reception. The complete heat engine therefore includes the boiler in which heat is given to the steam, the condenser in which heat is extracted from it, and the condensate pump and feed pump which restore the condensed steam to boiler pressure.

The third method therefore relates to the heat engine as a whole, and aims at expressing its performance as a ratio of the net output, in equivalent heat units, to the heat energy latent in the fuel consumed. Such a ratio is known as the overall thermal efficiency. Its use is clearly necessary if satisfactory comparison is to be made between heat engines of different types, employing thermodynamic cycles of different character.

Inquiry must therefore be made into the conditions which make for the highest thermal efficiency. Now if it be presupposed that the highest possible efficiency of heat transmission in the boiler has been obtained, and the highest possible intrinsic efficiency of the turbine, there still remains another factor of supreme importance, namely, the efficiency of the thermodynamic steam cycle which alone determines the ratio between the heat supplied to the steam and the pressure energy that is available for the turbine. The turbine is able to use efficiently all the available energy that can be given to it, and it therefore remains to provide that the efficiency of the thermodynamic cycle shall be made as high as possible subject to practical conditions. At this point the problem becomes a thermodynamic one, and this ratio is a function of the conditions of heat reception and heat rejection.

The law which governs this question was enunciated by Carnot more than a century ago. It is that in order to obtain the maximum thermodynamic efficiency the temperature of heat reception must be made as high as possible and the temperature of heat rejection as low as possible. In the perfect Carnot cycle heat is received at a constant high temperature and abstracted at a constant low temperature. The heat received is proportional to the absolute temperature of reception, and the heat abstracted to the absolute temperature of rejection. The difference between these quantities of heat is the amount transformed into work, so that the thermodynamic efficiency of the perfect engine becomes $(T_1 - T_2)/T_1$ where T_1 and T_2 are the higher and lower absolute temperatures. It is easily seen that this ratio is increased by increasing T_1, or by decreasing T_2, or both.

The past success of the steam engine as a prime mover is due to two causes, the high value of the latent heat of steam and its ability to work on what is known as the Rankine Cycle. In the latter the compression stage of the Carnot cycle is replaced by the simple process of elevating the condensed water to boiler pressure. The consequent reduction of negative work gives this cycle a great practical superiority.

On the other hand, the employment of such a cycle involves a departure from the above-mentioned principle of heat reception at a constant maximum temperature. The heat is in fact supplied to the steam at a variety of temperatures. The feed water has to be raised from condenser temperature to the boiling point corresponding to the pressure of the boiler. Evaporation in the boiler takes place at that temperature, and the temperature of the steam is then raised continuously to the maximum temperature of superheat. The thermodynamic efficiency of each portion of the heat so supplied is conditioned by the ratio of the absolute temperature of supply to the absolute temperature at which all the heat is abstracted in the condenser.

Now the heat given to the steam during the process of evaporation, namely, the latent heat, is a large proportion of the total heat supplied. For example, with a boiler pressure of 250 lb. per square inch, a superheat of 200° F. and a condenser vacuum of 29 in. Hg. the latent heat is 836 B. Th. U. per lb. of steam out of a total supplied of 1276 B. Th. U. per lb. during the three processes just mentioned, or 65·5 per cent of that total. Omitting the heat required to heat the feed water, since, as will be seen presently, the disability of the low temperature of this process can be overcome, the total heat required for evaporation and superheat is 950 B. Th. U., of which the latent heat added during evaporation is 88 per cent. It is clearly, therefore, of importance from the point of view of obtaining the highest thermodynamic efficiency of the cycle that the heat supplied during the stage of evaporation shall be supplied at as high a temperature as possible. The temperature of this part of the heat reception can only be raised by increasing the boiler pressure.

At the same time, an increase of the maximum temperature of the superheated steam will lead to further improvement in efficiency, since this means additional heat reception at the highest temperature. In the case of superheat, there is the additional advantage that with a higher degree of initial superheat, the steam is in a dryer condition in the final stages of its expansion.

The circumstances are best visualised by means of an entropy temperature diagram. Fig. 1 is such a

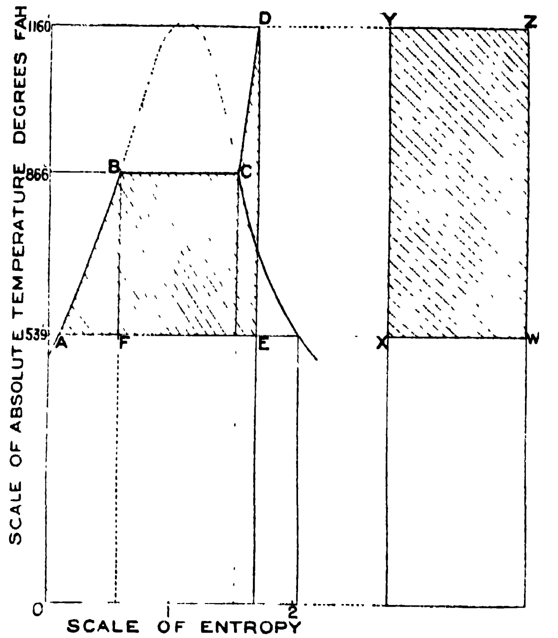

FIG. 1.—Entropy temperature diagram for the Rankine cycle for steam with boiler pressure 250 lb., condenser temperature 79° F. and superheat to 700° F.

diagram representing the Rankine cycle for steam with a boiler pressure of 250 lb. gauge, a condenser temperature of 79° F., and superheat up to a maximum temperature of 700° F. Each stage of the cycle is represented by a curve on the diagram, and the property of the diagram is that, with absolute temperature as the vertical ordinate, the area vertically beneath any curve, or portion of a curve, which corresponds to a change of state is proportional to the heat taken in or given out during that change. The rising curve *AB* represents the heating of the feed water to boiler temperature, by whatever means it is carried out; the line *BC* represents the generation of steam and is horizontal because this takes place at constant temperature; the rising curve *CD* represents the superheating of the steam. No heat is taken in or given out during expansion in the turbine, so that the vertical line *DE* represents expansion of the steam down to the temperature of the condenser. In the condenser, condensation takes place at constant temperature, and is therefore represented by a horizontal line *EA*, which completes the cycle. The area enclosed by the cycle *ABCDEA* represents the excess of the heat taken in from the boiler along *ABCD*, over that rejected into the condenser along *EA*. This area therefore represents the energy which is available for conversion into work.

The shortcomings of this cycle can be seen at a glance if we compare it with another cycle *XYZWX* in which all the heat received from the source is taken in at the highest temperature along *YZ*, and that rejected is rejected at the lowest temperature along *WX*. Here the work done is represented by the area of the rectangle *XYZW*, whilst the heat taken in is represented by the larger rectangle from *YZ* down to the base line. The proportion of the work done to the heat taken in is much higher than in the cycle *ABCDE*, and this is clearly seen to be due to the high temperature at which all the heat is taken in along *YZ*. The underlying areas of the first diagram shew us at once that, of the heat taken in along *AB*, that is, during the heating of the cold feed in the boiler, only a small percentage is converted into useful work. The heat taken in along *BC*, which is the latent heat of the steam, contributes a larger percentage, but still considerably less than the maximum. Even that received along *CD* during the process of superheating, yields less than the ideal maximum efficiency.

While the diagram thus exhibits the shortcomings of the Rankine cycle in comparison with an ideal Carnot cycle, it is of interest to remark that similar departures from the ideal are present in any type of engine in practical use. The internal-combustion engine, for example, contains an even greater departure from the ideal of constant temperature reception of heat, although its actual temperatures both of reception and rejection are higher throughout than in the steam engine.

Returning to the Rankine cycle for steam, it has been stated that the heat received during evaporation is a large proportion of the total heat received. That this is the case is readily seen from the diagram, this heat being represented by the area below *BC* down to the base line. By what is known as cascade feed heating, that is by heating the feed water by steam bled from the turbine at suitable successive stages, it is possible to a large extent to eliminate that part of the diagram which underlies *AB*, since by this process if carried out in its entirety the heat represented by the area from *AB* down to the base line can be saved, at the expense of a loss of work which can be shown to be equivalent to the area *ABF* for each lb. of steam. To raise the temperature of reception of the heat absorbed during

evaporation, which in the case already considered is 88 per cent. of the total heat absorbed along *BCD*, would clearly result in considerable improvement of the efficiency of the thermodynamic cycle. Thus not only high temperatures, as in the case of the adoption of high superheat, but also high boiler pressures, lead to a substantial increase in over-all thermal efficiency.

The question of the improvement of the thermal efficiency of the steam engine by such means is one of prominent interest in the engineering world at the present time. Advances in this direction have already been made for land installations, and recently we have witnessed an application of the same principles to marine work, which had been awaited with keen interest, and was not without an historic setting. It is just a quarter of a century since the first commercial application of the steam turbine to marine work was made in the Clyde river steamer the *King Edward*, which, built in 1901, has continued in successful service season by season up to the present time. A new vessel, which has a high-pressure steam installation of geared turbines on the lines indicated above, has been built for the same owners and for the same service. This vessel, which has been named *King George V*, becomes in its turn the pioneer of the new system.

Malaria and the Mosquito.

THE enthusiast who is 'eradicating' malaria by any or all of the well known methods, should cease for a while from his labours and study the short report recently issued by the League of Nations and referred to below.[1] In Col. James's words, "He will at least realise what a great waste of effort is involved in measures directed against the breeding-places of mosquitoes as a whole and even in similar measures directed against one species. He will begin to appreciate how the secret of a successful control of malaria lies not in the general knowledge that the disease is spread by mosquitoes of a certain kind, but in the particular exact knowledge of the life history of the few individual mosquitoes which succeed in becoming transmitters of the disease."

This is a refreshingly new aspect of the problem. The enthusiast eradicates all mosquitoes. He does not stop to distinguish a Culicine (non-malaria) from an Anopheline (malaria) mosquito; he is out to destroy them all. Now he is advised to study not only the species of Anopheles which are concerned in transmission, for all are not, but also actually to concern himself about infected individuals! Why should he do this? It is because "Malaria is essentially a household disease and particularly a disease of certain kinds of houses . . . . Malaria should be dealt with in the houses of the people rather than in the environment." We have called this a new aspect of the problem, but the author points out that some twenty-five years ago Stephens and Christophers in their reports to the Royal Society directed attention to "fever houses." They state: "We may look upon such a house and its accessory hovels as one infected with malaria or as 'a fever house.' Such is the universal condition of European houses indeed in the remote stations situated in the African bush. It is in such houses that the malarial cachectic is living, exposed to frequent or even constant re-infection and in which every traveller staying the night is liable to infection. From such fever houses the majority of our cases of blackwater have come."

It has always been somewhat disconcerting that while, for example, in a native African village more than 75 per cent. of the children may be infected with malaria, yet the infection rate of sporozoites (infective stage of the malaria parasite) among the anophelines may be low, less than 5 per cent. Once infected, however, a single mosquito becomes exceedingly dangerous; how much so is shown by the fact that a mosquito which has lived (in captivity) 1-3 months and has bitten nearly half a hundred people in that time may still have numerous sporozoites in its salivary glands and is consequently still potent for mischief. But, on the other hand, if not bitten oneself, one may draw comfort from the fact that a mosquito is gradually purging itself of infection by biting other people, so that while 85 per cent. of mosquitoes showed a salivary glands infection on the 50th day, on the 70th day this was reduced to 20 per cent. (the glands, moreover, containing but few sporozoites), the mosquitoes having bitten about a dozen people in the interval. This at first sight appears inconsistent with the previous statement, but the difference lies in the fact that in the first case the mosquitoes' stock of sporozoites in the glands was being replenished by the oocyst stage present in the stomach, as shown by dissection, while they were absent in the second case.

Col. James's observations lead him to formulate some very important conclusions, namely, that "in Nature the only mosquitoes which succeed in transmitting malaria are those rare individuals who happen to pass their lives in conditions which resemble very closely those which we have found to be essential for the successful transmission of the disease in experimental work" and of these "not many will ultimately become infective." Let the sanitarian then pause and study the individual infective mosquito in the fever house. Here is the real centre of gravity.

Among interesting data with regard to the life of the malaria parasite in the mosquito are those concerning the persistence of oocysts and sporozoites, the young and the mature stages of the malaria parasite in the stomach and salivary glands respectively of captive hibernating mosquitoes, a persistence which is held to explain primary attacks of simple tertian malaria in Nature in the early spring in northern latitudes.

The report concludes with a study of the infected cases from the clinical and microscopical sides. They suggest that we shall have to revise somewhat our idea of the Golgi cycle in relation to the temperature chart, but in blood work we must never forget that the peripheral blood is almost certainly not the same thing as that of the spleen or marrows. Very prudently, we consider, the author refuses to sail on the troubled sea of immunity where shipwrecks are inevitable. The report is written in an agreeably clear fashion with an absence of assumption of authority quite charming.

J. W. W. S.

[1] League of Nations: Health Organisation - Malaria Commission. Report on the First Results of Laboratory Work on Malaria in England. By Lieut.-Colonel S. P. James and P. G. Shute. (C.H./Malaria/57) (1).) Pp. 30. Geneva: League of Nations; London: Constable and Co., Ltd., 1926.)

Obituary.

PROF. J. G. ADAMI, C.B.E., F.R.S.

GEORGE ADAMI was a great pathologist, though not a ' laboratory man ' in later years. A scholar and Darwin prizeman of Christ's College, Cambridge, he took a first class in the Natural Science Tripos, then studied in Paris with Pasteur and Roux, in Breslau with Heidenhain, and in Cambridge with Roy and Michael Foster. Afterwards he became John Lucas Walker student, and at the early age of thirty, professor of pathology and bacteriology at McGill University, Montreal. Through his inspiration, Sir Humphry Rolleston has written: "a continuous stream of papers" issued "from his laboratory dealing with all branches of pathology and its application to other sciences." He was awarded the F.R.S. in 1905 and the Fothergillian gold medal of the Medical Society of London in 1914. He was an ex-president of the Association of American Physicians, a fellow of both Jesus and Christ's Colleges, and held many honorary degrees. During the War, Adami became assistant director of Medical Services in the Canadian Army, for which he received the C.B.E. A member of the War Office Committee on the Medical History of the War, he published in 1918 vol. 1 of the "War Story of the Canadian Medical Corps." He was chairman of the Committee on Bacteriological Procedures, Medical Research Committee, and was largely responsible for the standardisation of Wassermann technique in the laboratories of Great Britain.

Adami's greatest contribution to science was the "Principles of Pathology." The first volume on general pathology, published in 1908, marked an epoch. It was, as stated in the preface, "not a mere record and description of phenomena, but an attempt to analyse those phenomena in an ordinary manner." It contained his exposition of inflammation and his original and helpful classification of neoplasms upon an embryological basis. Four years later he published with his friend Dr. John McCrae, of McGill University, his popular text-book of pathology. Other contributions to science included "The Physiology and Pathology of the Mammalian Heart" with Roy (*Phil. Trans.*), Pictou cattle disease, and a survey of the 1918 influenza epidemic in the British Army. In his Croonian lectures on adaptation and disease, delivered at the Royal College of Physicians in 1917, Adami argued against the doctrine that acquired characters are not transmitted. He was greatly interested in the problem of malignancy, and in the *Medical Journal and Record*, New York, August 18, 1926, controverted the view "that one particular order of microbe is concerned in the production of all malignant tumours;" he believed that the colloidal lead treatment was an "advance."

Adami accepted in 1919 the arduous post of vice-chancellor of the University of Liverpool. By his broad and practical outlook on life, his buoyant energy, his genial friendship, and his high ideals, he ennobled the University and the City of Liverpool and brought the two into closer and more intimate relationship. He faced his gradually failing health with unflinching courage, carrying out his duties to within a few weeks of his death. ERNEST GLYNN.

THE news of Vice-Chancellor Adami's death came as a great shock to his personal friends, and no man had more: for so great was his passion for pleasant intercourse, and his enjoyment of human fellowship, that he sought and made firm friendships where other men would have only multiplied acquaintances. To meet him was a pleasure which he always actively developed, striking sparks from stones, and even finding entertainment in dullards. Doubtless it was partly this side of his character which found satisfaction in the very onerous post of vice-chancellor in the midst of this busily employed provincial city: a post which he filled with distinction, and with a grace which few could imitate. Not very different was that other interest which could leave no medical problem untouched, and carried him, enthusiastically always, through the wide-spread fields of knowledge in the subject of which he was a master, ever curious to meet new developments and always with the firm hand which grasped what others were satisfied with merely touching.

Gifted with this spirit of adventurous and penetrating curiosity, a man of incessant industry, and with a natural facility of expression and delight in exposition, his scientific papers and lectures have since his earliest days excited marked admiration: and to many it was a matter for regret that this more widely-known side of his activities was submerged in the daily routine of an administrative post. However, in Liverpool, an occasional lecture to a local society frequently disclosed the talents which his administrative duties otherwise concealed: and even to those to whom his main subject was a closed book, he was a shining example of the light which the University represented in the lives of the younger generation to which he patiently struggled to make it more and more accessible.

Resident long in Canada, familiar with methods of co-operation better known there than in our more conservative home-surroundings, Adami was sincerely an advocate of modes of procedure, methods and manners of organisation, which are not quite our own: and this advocacy was not without some discovery that habits and tastes were not readily remodelled. Such surprises must come to every man of action who ventures into new fields, and there the weaker spirit fails. Adami's spirit never flinched. Through every temporary conflict his buoyancy survived, and the geniality of his character helped him ably to overcome any lingering remnant of hostility.

Nor is this perhaps without some application to the endeavours in medical progress with which Adami has been most closely associated in the last few years of his life. Cancer, as he phrased it, is a *killer*, therefore it must be fought, and that by *team-work*. Absolute sincerity, tremendous enthusiasm, great breadth of knowledge and keenness of insight, and yet opposition, as natural as the clouds, which he somehow failed to understand.

Splendid gifts, sturdily continued efforts, great endeavours, all carried in a nature that was poised and balanced as by an internal gyrostat of goodwill and honourable intention; none of these qualities have

been without success in the realms of science, medicine, and affairs. In Liverpool his efforts to strip the University of its shell and bare it to the life of the City have left a permanent effect of greatest value, by which he will be remembered here for many years to come. *Vale!* J. S. MACDONALD.

DR. J. L. E. DREYER.

ON September 14, Dr. John Louis Emil Dreyer died at the age of seventy-four years from an illness which he had resisted for the greater part of a year with an astonishing vitality. By his death astronomers are deprived of the presence of one of the most distinguished historians of their science. There are others who have treated the history of astronomy more comprehensively, but within the wide range of his labours there is certainly none who has excelled Dr. Dreyer in the combination of learning, sagacity, scholarly precision, and clear and well proportioned exposition.

Dr. Dreyer was descended from a family which had long been distinguished, largely as soldiers, in the public service of Denmark. The son of Lieutenant-General F. Dreyer, he was born at Copenhagen in 1852 and was educated at the University of Copenhagen. In 1874 he came to Ireland as astronomer at Lord Rosse's Observatory at Birr Castle. Lord Rosse's famous telescope had been found to be specially adapted to the observation of nebulæ, and Dreyer in consequence embarked on the study of nebulæ, with which, next to his studies in the history of astronomy, his name is most closely associated. In 1878 his work on nebulæ was interrupted by his appointment as assistant astronomer at the Royal Observatory at Dunsink, but it was revived on his appointment in 1882 to be director of the Armagh Observatory. While at Birr he prepared for publication the whole series of observations made with Lord Rosse's telescope from 1848 to 1878, published by Lord Rosse in the *Transactions of the Royal Dublin Society*, 1880, and he also published a supplement to Herschel's catalogue of nebulæ with numerous corrections. At Armagh, in addition to minor studies on nebulæ, he produced in 1888 the "New General Catalogue of Nebulæ and Clusters of Stars," included in the forty-ninth volume of the *Memoirs of the Royal Astronomical Society*, which, with his two supplementary catalogues published in the same series in 1895 (vol. 51) and 1908 (vol. 59), form the standard catalogues to which reference is always made.

While at Dunsink, Dreyer joined Copeland in founding an international astronomical journal called *Urania*, the first number of which appeared in January 1881. In July of that year its name was changed to *Copernicus*. The last number appeared in June 1884. The editors contributed their full share of reports and articles, and the journal is full of matter which, after more than forty years, remains both interesting and instructive. Dreyer's most important contribution was his "New Determination of the Constant of Precession," vol. 2, pp. 135-155, which, though never adopted in practical work, was used by Newcomb in his classical determinations.

At Armagh Dreyer produced in 1886 the "Second Armagh Catalogue of 3300 Stars," but his subsequent publications have been restricted to nebulæ and astronomical history. In 1890 he produced "Tycho Brahe, a Picture of Scientific Life and Work in the Sixteenth Century." Danish patriotism has given rise to much research on Tycho Brahe, but Dreyer found no scholarly biography, which should at once establish the facts in the light of the evidence available and at the same time place Tycho in his true position in relation to the progress of astronomy and to the life and thought of his time. Dreyer's volume, which is as illuminating as it is scholarly, supplies this want. In 1913 he began the publication of a complete edition of Tycho's works, of which ten volumes have appeared and the remaining four are stated to be complete in manuscript. This edition must probably be regarded as in the main a work of piety. The preparation of the text must have been a laborious task. The notes, in Latin, are brief, but exhibit the editor's usual scholarship. He has among other things taken the pains to discover what editions of the classics Tycho used.

In 1906 appeared Dreyer's "History of Planetary Systems from Thales to Kepler." The history of planetary systems for those ages is practically the history of astronomical theory. Here as usual we find that mastery of authorities and that sober judgment in weighing doubtful evidence that we should expect from a scholar alone, combined with that skilful interpretation and sympathetic exposition that only an astronomer could give. Dreyer returned to parts of this subject in two papers contributed to *Monthly Notices of the Royal Astronomical Society* in 1917 and 1918, in which he effectively disposed of the long prevailing idea that Ptolemy's star catalogue did not rest on his own observations, but on those of Hipparchus or Menelaus reduced to his own time. In 1920 he succeeded, largely as a result of research on manuscripts at Oxford, in restoring the original form of the Alfontine Tables (*Mon. Not. R.A.S.*, vol. 80, pp. 243-62). He took the leading part in the editing of Sir William Herschel's "Scientific Papers," published in 1912, and a very large share in the volume which the Royal Astronomical Society has recently produced on the first hundred years of its history.

Distinctions came as a matter of course. In 1916 Dreyer received the gold medal of the Royal Astronomical Society, of which he was president from 1923 until 1925. He received the honorary degree of D.Sc. from the University of Belfast, and of M.A. from the University of Oxford, in which city he had settled on his retirement from Armagh in 1916.

In private life Dreyer was unobtrusive, but accessible. He spoke quietly, and with the same deliberation and authority with which he expressed himself in public. His learning was always available to those who wished to benefit by it, and he will be greatly missed. His wife, a daughter of John Tuthill, of Kilmore, Co. Limerick, whom her friends hold in affectionate remembrance, died in 1923. He leaves three sons, all distinguished in the fighting services of the British Crown, and one daughter, who is married to Mr. Warham Shaw-Hamilton, late of Dartan, Co. Armagh.

MR. J. H. MUMMERY, C.B.E.

THE death of John Howard Mummery on August 30, whilst on a holiday visit to Cornwall, deprives the world of an eminent microscopist. Born on January 19,

1847, he was educated privately, previous to entering the medical school of University College Hospital. After qualifying as a member of the Royal College of Surgeons, and taking his L.D.S. diploma, he joined his father, a well-known dental surgeon and research worker, in practice in Cavendish Place, London, W.

During his studentship, whilst working under Sharpey, Mummery showed great aptitude for microscopic technique; this bent he developed to a remarkable degree. Specialising in dental histology, admittedly one of the most difficult branches of the art, he achieved a world-wide reputation. His most important papers were contributed to the *Philosophical Transactions of the Royal Society*, and include "Some points in the Structure and Development of Dentine," Ser. B, vol. 182, 1892; "On the Distribution of the Nerves of the Dental Pulp," Ser. B, vol. 202, 1912; "On the Process of Calcification in Enamel and Dentine," Ser. B, vol. 205, 1914; "On the Nature of the Tubes in Marsupial Enamel and its Bearing on Enamel Development," Ser. B, vol. 205, 1914; "On the Structure and Development of the Tubular Enamel of the Sparidæ and Labridæ," Ser. B, vol. 208, 1914; "The Epithelial Sheath of Hertwig in Man, etc.," Ser. B, vol. 209, 1919; "On the Nerve-end Cells of the Dental Pulp," Ser. B, vol. 209, 1920. Of these, the most remarkable is that dealing with the final distribution of the nerves of the dental pulp. Here was a problem the solution of which had been attempted by many workers; by dogged patience Mummery succeeded in demonstrating the passage of fine neuro-fibrils into the dentinal tubes. His work, too, on enamel tends to prove that this tissue is not wholly inorganic in structure but possesses an organic content, and is capable of exhibiting a vital reaction to injury and disease.

It is impossible here to allude to all of Mummery's numerous papers, dealing not only with the histology of normal tissues, but also many others of a pathological nature. These are to be found in the *Transactions of the Odontological Society of Great Britain*, *Proceedings of the Royal Society of Medicine*, and various British and foreign medical and dental journals; his last, "The Pathology of Chronic Perforating Hyperplasia of the Pulp," appeared in the *British Dental Journal* within a month of his death.

In 1919 Mummery published his text-book "The Microscopic Anatomy of the Teeth," which at once became popular with students. A second edition in 1924 was enlarged to include the general anatomy of the teeth, both human and comparative, and will no doubt remain a standard text-book for years to come.

Mummery was a first-class draughtsman, and his publications are enriched and their value enhanced by his own delightful drawings, in addition to the photomicrographs of his brilliant sections. He was also a water-colour painter of considerable merit.

It is given to but few to remain in active work, with intellectual powers undiminished, for four score years. To his intimate friends Mummery never appeared old. After visiting him in his study one came away stimulated by the suggestions emanating from his fertile brain, and steeped in admiration of his broad and catholic outlook.

Many honours came to Mummery; he was a past president of the old Odontological Society of Great Britain, and the first president of the Section of Odontology of the Royal Society of Medicine, which Society afterwards elected him an honorary fellow. The Royal College of Surgeons of England elected him a fellow and awarded him the Sir John Tomes Prize in 1897. He was a past president of the British Dental Association, and chairman of its representative board. International honours were also his; the University of Pennsylvania gave him its D.Sc. degree; he was president of the sixth International Dental Congress, and was awarded the Miller Prize by the International Dental Federation in 1922 for his original research in dental histology. During the War he acted as superintendent and registrar of the Maxillo-Facial Hospital, for injuries of the face and jaws, at Kennington, and for his services there received the C.B.E.

Mummery will ever rank among the worthies of his profession, as a distinguished follower of Thomas Bell, James Salter, John and Charles Tomes. M. F. H.

WE regret to announce the following deaths:

Prof. F. W. Gamble, F.R.S., Mason professor of zoology and comparative anatomy in the University of Birmingham, on September 14, at fifty-seven years of age.

Dr A. W. Rowe, Lyell medallist of the Geological Society in 1911, who was distinguished for his researches on the zones of the White Chalk of Kent and Sussex, on September 17.

News and Views.

ON September 17, the *Morning Post* published a Reuter message from Berlin to the effect that Profs. Paneth and Peters of that city had, after years of experimenting, succeeded in transforming hydrogen into helium "with the aid of particles of metal." This announcement, if correct, is of great importance and will evoke even more interest than the claim by Miethe and Stammreich to have transmuted mercury into gold. The two claims differ, however, in the important respect that whereas the experiments of Miethe and Stammreich, and of Smits, indicated disintegration of heavy atoms into lighter ones, those now announced involve the synthesis of an element from a lighter one, thus more nearly approaching the alchemist's dream of changing the relatively light base metals into the heavier gold and silver.

To judge by the published literature, recent efforts at the transmutation of elements seem to have been concentrated on disintegrating heavy atoms—a course doubtless suggested by radio-active disintegration and by Rutherford's transmutation experiments with α-particles—but modern views on atomic structure also adumbrate the possibility of synthetic transformations. According to these views the hydrogen atom consists of one positively charged unit of electricity (a proton) with a single electron revolving round it; and the helium atom contains a nucleus

of four protons and two electrons with two external electrons; so that the problem, on paper, consists in condensing, as it were, four hydrogen atoms into one helium atom, or of bringing into close association four independent protons and two electrons. No particulars are yet to hand concerning the methods adopted by Profs. Paneth and Peters, for the statement "with the aid of particles of metal" is meaningless as it stands. The experimental difficulties must be very great, not only in obtaining the energy necessary for such a change, but also in applying it under the appropriate conditions. Moreover, helium is an atmospheric gas, and traces of it are extremely difficult to eliminate by the methods of evacuation and adsorption at present in use; so that belief or disbelief in the Reuter message must be reserved pending further and more definite evidence.

THE German Scientific and Medical Association (Gesellschaft Deutscher Naturforscher und Ärzte) has now issued a handbook of the eighty-ninth assembly at Düsseldorf on September 19-26. From May to October of this year there is in Düsseldorf an exhibition for Hygiene, Social Welfare, and Physical Exercises: 'Gesolei' (GEsundheitspflege, SOziale Fürsorge, und LEIbesübungen). A series of separate societies hold their meetings at the close of the association assembly, which has therefore something of the character of a federation. Excursions include Bonn, Eifel, Neanderthal, and Holland, but chiefly the Rhine-Westphalian industrial area, for example, the Leverkusen dye-works. Dusseldorf is not now in the occupied area, but it has been occupied and is still near the occupied area. As in Innsbruck in 1924, the emotional undertone of the meeting may emphasise that political boundaries cannot divide the solidarity of civilisation (Kulturgemeinschaft).

THE Press bureau at Düsseldorf is in charge of Dr. R. Plohn, and two kinds of abstracts will be prepared—a general report for the daily Press and detailed abstracts for the technical Press. Those using the Press bureau are asked to acknowledge its assistance by sending two copies of any published report. The long list of papers to be presented is arranged in 34 sections. Sections 1 to 15 are the scientific sections. Section 15, presided over by Dr. Rein, is concerned with scientific education; and to the discussion on educational reform medical members are particularly invited. The remaining sections, 16 to 34, are medical, but 16 deals also with the general history of science. The chief addresses will appear in *Die Naturwissenschaften* and also as *Verhandlungen*, to be obtained by members and *Teilnehmer* for 4·50 gold marks either in Düsseldorf or by sending to the Geschäftstelle der Gesellschaft, Leipzig, Gustav-Adolf Strasse 12, to the public through booksellers for 6 gold marks.

A VIVID and intriguing discussion of possible developments in the cotton industry, by Dr. W. Lawrence Balls, will be found in the pages of the *Nineteenth Century* for August. Dr. Balls points out that cotton as a crop suffers from the fact that it inevitably competes for space which is suitable for a food crop, a competition in which the scales are weighted against it in the long run by the continual growth of population; on the other hand, some forms of its new competitor, artificial silk, are made from wood pulp and can be nourished by the spaces in the world that are not available for arable cultivation. Reference is made to the difficulty met with by the grower in the new areas trying to develop cotton production, when he tries to learn what demands the industry makes as to quality in his crop. The industry is so complicated, and divided into so many water-tight compartments, that from different types of spinner and weaver different and often contradictory demands are emphasised, often on very inadequate because too specialised experience. From that point forward, Dr. Balls indicates the inestimable value of the formation of the British Cotton Industry Research Association and the Empire Cotton Growing Corporation; these two organisations have made it possible "for the man from overseas to learn more in a day than he could formerly glean in a month, while the mill manager has become independent of Press stunts." The growing extension and improvement in technique in the production of artificial silk have undoubtedly brought about a new stage in the development of the cotton industry. Much interest therefore attaches to Dr. Balls' forecast, which he admits is heterodox, that whilst cotton will retain its place as a 'structural' material it will lose it as a mere 'covering' material; a change that implies a considerable shrinkage in volume of the cotton industry coupled with specialisation in quality, both of raw product and manufactured article.

PROF. JOHN M. COULTER gives an account of the new Boyce Thompson Institute for Plant Research at Yonkers, New York, in the *Scientific Monthly* for August. This account, with its accompanying photographs, shows how private endowment in the United States has supplied an instrument for fundamental research upon plants which has no counterpart in Great Britain. The only endowed institute which is directing research into fundamental problems of plant culture in Britain is the John Innes Horticultural Research Institution, which, under the late Dr. Bateson, obtained world-wide recognition as a centre of investigation into genetics, and under its new director, Sir Daniel Hall, may be expected to widen its field of attack. The new Boyce Thompson Institute provides a laboratory and greenhouse equipment for the study of the plant under controlled conditions which far exceeds that at the disposal of any British research station whether supported by public funds or private endowment. Col. W. Boyce Thompson was impressed, in making his liberal endowment of the institute that bears his name, with the dependence of the whole population upon plants and their products. In a crowded isle like Britain this is even more impressed upon the consideration of both Government and liberally minded citizens, and though the resources provided by the State may not permit of such extensive researches upon physiological problems of plant development and growth, the annual reports for

1925 of such stations as Long Ashton, near Bristol, and East Malling in Kent, which have recently been issued, show what extensive and thoroughly scientific work into problems of fruit and vegetable culture is in progress.

EAST Malling Research Station has now been established for some fourteen years, whilst Long Ashton commenced work about the beginning of the century. Both these stations have to confine themselves to fruit and vegetable problems, but for many years the Edinburgh Botanic Gardens have been noted for their experimental study of problems of propagation with both garden and greenhouse plants. Valuable aid in the study of commercial greenhouse plants is also given now by the Cheshunt Station in the Lea Valley, which has been associated both with Rothamsted and with the Department of Plant Physiology of the Imperial College of Science and Technology. A brief account of the work of this station from the pen of Prof. Mangham, appears in *Modern Science* for August 1926.

THE *Chemist and Druggist* for July 10 contains a beautifully illustrated account of the chief botanical gardens of Europe, and also a separate account, with equally charming illustrations, of the wonderful gardens established by the late Sir Thomas Hanbury at La Mortola. British botanists will be interested in both these articles, and many of them will have benefited by the generous policy pursued at La Mortola in the distribution of seed to British botanical departments. Another article of considerable interest in the same issue is the account by Prof. Jan Muszyński, of Vilna, of the medicinal herb fair held annually at that town on June 24. No fewer than 122 different kinds of herbs are collected and offered for sale by the peasant drug harvesters at the annual fair, and as the author, who is professor of materia medica at the University, points out, recent work on vitamins, hormones, etc., rather stresses the fact that the herb may mean considerably more in therapeutics than the pure drug extracted from it.

THERE are so many phenomena in connexion with the reception of long distance radio signals that it is very difficult to give satisfactory explanations of the variations in the intensities of the signals. Mr. L. W. Austin in the *Journal of the Washington Academy* (vol. 16, p. 398) gives a résumé of measurements made by the Bureau of Standards on these signals and on atmospheric disturbances during 1925. One of the methods used was to compare the intensity of the received signal with that of an artificial signal of adjustable intensity produced by a local radio frequency generator. The principle of the method is identical with some of those used in Europe. No certain relationship has been discovered between sunspots and abnormal signals. To do this a complete study over at least one complete sunspot cycle would be necessary. Directional measurements on the atmospheric disturbances were made at frequencies of 21·4 and 15 kilocycles at the U.S. Naval receiving stations at Colon and Balboa, the two ends of the Panama Canal. During the dry season, that is, from January 15 to April 1, the disturbances at both stations come almost entirely from the direction of the high Andes in Northern Colombia. When the dry season is over, local storms begin and disturbances coming from the low mountains of the isthmus are prominent. In midsummer the direction of the incoming disturbances at Colon is roughly south-east, while at Balboa the direction of the disturbances is north or north-west. The observations prove that both stations give equally good reception to signals coming from the north during the dry season, but during the rest of the season the Colon station should give much better reception. Observations in Washington show that in winter the prevailing afternoon disturbances seem to come from the direction of eastern South America or possibly from Africa. In summer the direction is south-westerly, apparently from Mexico or the south-western United States. This agrees with the hypothesis that disturbances generally originate over land and are most intense in the afternoon and evening in the regions where the sun passes very nearly overhead.

MR. J. T. CUSWORTH, Upperthorpe, Sheffield, sends us a copy of notes made by him during the severe winter of 1885–6 on the vitality of a frog which was frozen in the centre of a block of solid ice. At the end of eight weeks the block of ice was carefully broken, and the frog, which was frozen stiff, was placed near a fire. In less than half an hour it was leaping about. Mr. E. G. Boulenger, director of the Aquarium at the Zoological Gardens, Regent's Park, has been good enough to send us the following comments upon this communication: "It is well-known that batrachians and fishes may revive after having been frozen stiff for several months. So far as I am aware, however, exactly how long life may be thus suspended is not established. In the rivers of Siberia, which may be frozen solid, fishes are often imprisoned for months on end and during such period assume a rigid condition, their vital functions being temporarily suspended. This fact suggested experiments in the freezing of live fish for transportation, and some were conducted in Switzerland and America several years ago. As a result of these, it was found that fish could be frozen stiff for from two to three months, showing no signs of ill-health, when thawed, as a result of their prolonged imprisonment. The fish which in certain parts of America are now sometimes transported on a commercial scale embedded in ice, are first placed in a closed tub of water into which oxygen under pressure is introduced. After being kept just above freezing-point for three days they are frozen solid. The blocks of ice containing the fish are then removed from the tubs and are surrounded with heat insulating packing. Under such conditions they can be kept in cold storage until wanted. The cost of transporting live fish in water is prohibitive, about ten gallons being required for each pound of fish. The freezing method therefore saves expense."

PROF. J. W. MCBAIN, Leverhulme professor of physical chemistry, who for twenty years has been

on the staff of University College and the University of Bristol, has now accepted an appointment at Stanford University, California, U.S.A., where he will take up his duties after Christmas of this year. Miss M. E. Laing and Miss M. H. Norris have also been appointed to the staff of Stanford University.

THE Mineralogical Society, which was instituted on February 3, 1876, has just celebrated its jubilee in London. The programme included visits of delegates from foreign mineralogical and geological societies and invited guests to the British Museum (Natural History), South Kensington, and to other museums and institutions in London; a conversazione in the Geological Society's Rooms at Burlington House on September 21; and a dinner at the Connaught Rooms on the following evening. The celebration in London was preceded by an excursion (September 12-18) to Devon and Cornwall under the direction of Mr. Arthur Russell, and is to be followed by an excursion (September 23-30) to the north of England under the direction of Prof. A. Hutchinson

THE news columns of the daily papers during the past few days have contained long accounts of the disastrous hurricane which visited Florida on the night of September 17. According to the New York correspondent of the *Times*, the coastal region from Palm Beach to Miami was the area most affected, and it is estimated that 800-1500 lives were lost. The material damage is put at 30,000,000*l*. In Miami, wooden houses were ripped apart, concrete houses broken from their foundations, 'skyscrapers' were badly twisted, small shipping were lifted into the Royal Park, and the new docks were destroyed. The wind is stated to have reached a velocity of 130 miles per hour, and the first visitation lasted nine hours. Farther north there were also damage and casualties. The West Indies is one of the five regions of the globe where these violent tropical cyclones occur. When such storms arise in or near the West Indies, they generally pursue a curved path towards the north-west or into the Gulf of Mexico and then north-eastward along the Atlantic coast They lose their violence as they pass into the temperate zone The Galveston hurricane was apparently of even greater violence than that which has just occurred. It occurred in the same region on September 8, 1900, and on this occasion 6000 lives were lost and 6,000,000*l* worth of damage was done. The wind velocity was estimated as 120 miles per hour, and much destruction was caused by high tides and a storm wave. These storms occur in the West Indies most frequently between August and October. It seems a little remarkable that buildings of the character of 'skyscrapers' should ever have been erected in a region which is known to be liable to these violent tropical cyclones.

AN attractive series of lectures or popular 'talks,' calculated to interest the most diverse tastes, has been arranged for the coming winter on behalf of King Edward's Hospital Fund for London. The lecturers and subjects announced are as follows: Mr. H. L. Baird on seeing by wireless (October 7); Air Vice-Marshal Sir Sefton Brancker on flying to-day and to-morrow (October 14); Mr. W. E. Garner on liquid air (November 12); Sir Richard Paget on the artificial production of the human voice (November 19); Mrs. Rosita Forbes on her trans-Saharan journey (November 25); Dr. Ezer Griffiths on the romance of refrigeration (November 26). The lecture hour in each case is 5 P.M. The fact that these distinguished people are giving their services, and that the charges for the lectures are moderate, should insure that King Edward's Hospital Fund derives considerable financial benefit from the lectures, details of which can be obtained from the secretary of the Fund, 7 Walbrook, London, E.C.4.

IT has been pointed out that the table in the article on "Patent Office Statistics" in NATURE for September 18, p. 428, contains errors arising from the fact that 'inclusive' salaries and those carrying bonus are shown intermingled in the estimates. The writer of the article has accordingly prepared the following corrected table:

Department.	Total personnel	Number of personnel with salaries rising to a maximum of		Total of higher posts	Percentage of higher posts.
		1000*l* to 1800*l*	2000*l* and over		
Treasury	331	17	9	26	7·8
Foreign Office	839	24	3	27	3·2
Ministry of Transport	524	9	2	11	2·1
Board of Trade	567	7	5	12	[illegible]
Ministry of Agriculture	1197	14	3	17	1·4
Patent Office with Trade Marks and Design Branches	685	1	0	4	0·38

A SHORT manual on First Order Triangulation, by Rev. C. V. Hodgson, forms *Special Publication* No. 120 of the United States Coast and Geodetic Survey. Its purpose is to summarise the methods employed in executing first-order triangulation and base measurement The Survey now uses the term 'first order' in place of the term 'precise' or its earlier equivalent 'primary.' First order triangulation must have an average triangle closure of about 1″ or less, and a maximum closure not exceeding 3″. The closure in length upon a measured base must not exceed an error of 1/25000. The pamphlet contains chapters on instruments, organisation of parties, routine, sources of error, field computations, and base-line measurement. It is essentially practical, and pays little attention to theoretical considerations.

A CATALOGUE (Dept. No. 3, August) of second-hand books on natural history has reached us from Messrs. W. and G. Foyle, Ltd., 121 Charing Cross Road, W.C.2. It should be seen by readers on the look-out for natural history books, the range being large and the prices low.

DR. C. W. STILES, secretary of the International Commission on Zoological Nomenclature, informs us that a new (English) edition of the International Rules,

together with the summaries of 'Opinions' 1 to 90, has been printed in the *Proceedings of the Biological Society of Washington*, D.C., vol. 39, pp. 75-104, July 1926. Copies can be obtained from Dr. Thomas E. Snyder, the Secretary of the Society (address: Bureau of Entomology, U.S. Dept. of Agriculture, Washington, D.C.), price 1 dollar.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A chemist for research work on the evaporation rates and the ignition temperatures of vapours, of certain inflammable spirits used in industry as solvents, under the Safety in Mines Research Board —The Under-Secretary for Mines, Establishment Branch, Mines Department, Dean Stanley Street, S.W.1. (September 29). A head of the mining department of the Central School of Science and Technology, Stoke-on-Trent—The Clerk to the Governors, Town Hall, Hanley, Stoke-on-Trent (September 30). An assistant for technical records work in connexion with the Department of Scientific and Industrial Research—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (October 4). A senior lecturer in electro-technics at the University of the Witwatersrand—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (October 15). An engineer to take charge of the section of Wood Preservation of the Forest Products Research Laboratory at Princes Risborough—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (December 1). A director of agriculture in the Territory of New Guinea—The Official Secretary for Australia, Australia House, Strand, W.C.2 (December 15). An assistant lecturer in agriculture at the South-Eastern Agricultural College, Wye, Kent—The Secretary. Junior professional assistants in the Meteorological Office—The Secretary, Air Ministry, Adastral House, Kingsway, W.C.2. A senior woman library assistant at the School of Oriental Studies—The Librarian, School of Oriental Studies, Finsbury Circus, E.C.2. A laboratory assistant for the Veterinary Research division of the Agricultural Department of the Government of Kenya—Crown Agents for the Colonies, 4 Millbank, Westminster, S.W.1 (quoting M/14661). A mistress for physics at the Cowley Girls' School, St. Helens—The Secretary to the Governors of the school, 17 Cotham Street, St. Helens.

Our Astronomical Column.

RECENT NAKED-EYE SUNSPOTS.—The last naked-eye group of sunspots noted in these columns was No. 9, seen on the sun's central meridian on July 30. Another large group bordering on naked-eye visibility was in transit across the disc between August 10 and 22, but as some observers failed to see it, a number has not been assigned to it in our tabular list of these large spots. Since September 13, however, an important group has been an easy naked-eye object. This new group is composed of two very large spots, both of which could be seen separately through morning fog on September 18. On that day their apparent separation was 3½′, corresponding to 14½° of solar longitude between their respective centres.

When the spots first appeared round the sun's east limb on September 13, they were evidently of recent origin and growing rapidly, for within 48 hours their total area had doubled. On September 18 the area of the group was 3000 million square miles or 1/400th of the sun's hemisphere. The group ranks accordingly in size with the spot of last December as the second largest group seen as yet this cycle. The region of the sun in which the group occurs is very near that of No. 8, the central meridian passage of which was June 29. During the interval between the disappearance of group No. 8 and the formation of No. 10, the photosphere of that region was marked fairly strongly with faculæ. Particulars of position and area of the August and September spots are given below:

No.	Date on Disc.	Central Meridian Passage.	Latitude.	Area.
—	Aug. 10-22	Aug. 16·2	18° S.	1/1400
10	Sept. 13-25	Sept. 19·5	24° N.	1/400

COMETS.—Two periodic comets, Giacobini-Zinner and Neujmin, are due at perihelion in a few months. The former is interesting from the near approach that its orbit makes to that of the earth. Mr. Cripps has calculated the perturbation and finds December 7 as the date of perihelion. The following ephemeris for 0^h U.T. is from the B.A.A. Handbook:

	R.A.	N. Decl.	log r.	log Δ.
Sept. 30	16^h $50·3^m$	7° 15′	0·136	0·144
Oct. 8	17 8·2	5 5	0·115	0·133
„ 16	17 28·5	2 48	0·093	0·120
„ 24	17 51·7	0 25	0·070	0·105

The comet is fairly well placed in the evening sky being on the meridian about 4 P.M.

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on the staff of University College and the University of Bristol, has now accepted an appointment at Stanford University, California, U.S.A., where he will take up his duties after Christmas of this year. Miss M. E. Laing and Miss M. H. Norris have also been appointed to the staff of Stanford University.

THE Mineralogical Society, which was instituted on February 3, 1876, has just celebrated its jubilee in London. The programme included visits of delegates from foreign mineralogical and geological societies and invited guests to the British Museum (Natural History), South Kensington, and to other museums and institutions in London; a conversazione in the Geological Society's Rooms at Burlington House on September 21; and a dinner at the Connaught Rooms on the following evening. The celebration in London was preceded by an excursion (September 12-18) to Devon and Cornwall under the direction of Mr. Arthur Russell, and is to be followed by an excursion (September 23-30) to the north of England under the direction of Prof. A. Hutchinson

THE news columns of the daily papers during the past few days have contained long accounts of the disastrous hurricane which visited Florida on the night of September 17. According to the New York correspondent of the *Times*, the coastal region from Palm Beach to Miami was the area most affected, and it is estimated that 800-1500 lives were lost. The material damage is put at 30,000,000*l*. In Miami, wooden houses were ripped apart, concrete houses broken from their foundations, 'skyscrapers' were badly twisted, small shipping were lifted into the Royal Park, and the new docks were destroyed. The wind is stated to have reached a velocity of 130 miles per hour, and the first visitation lasted nine hours. Farther north there were also damage and casualties. The West Indies is one of the five regions of the globe where these violent tropical cyclones occur. When such storms arise in or near the West Indies, they generally pursue a curved path towards the north-west or into the Gulf of Mexico and then north-eastward along the Atlantic coast. They lose their violence as they pass into the temperate zone. The Galveston hurricane was apparently of even greater violence than that which has just occurred. It occurred in the same region on September 8, 1900; and on this occasion 6000 lives were lost and 6,000,000*l* worth of damage was done. The wind velocity was estimated as 120 miles per hour, and much destruction was caused by high tides and a storm wave. These storms occur in the West Indies most frequently between August and October. It seems a little remarkable that buildings of the character of 'skyscrapers' should ever have been erected in a region which is known to be liable to these violent tropical cyclones.

AN attractive series of lectures or popular 'talks,' calculated to interest the most diverse tastes, has been arranged for the coming winter on behalf of King Edward's Hospital Fund for London. The lecturers and subjects announced are as follows: Mr. H. L. Baird on seeing by wireless (October 7); Air Vice-Marshal Sir Sefton Brancker on flying to-day and to-morrow (October 14); Mr. W. E. Garner on liquid air (November 12); Sir Richard Paget on the artificial production of the human voice (November 19); Mrs. Rosita Forbes on her trans-Saharan journey (November 25); Dr. Ezer Griffiths on the romance of refrigeration (November 26). The lecture hour in each case is 5 P.M. The fact that these distinguished people are giving their services, and that the charges for the lectures are moderate, should insure that King Edward's Hospital Fund derives considerable financial benefit from the lectures, details of which can be obtained from the secretary of the Fund, 7 Walbrook, London, E.C.4.

IT has been pointed out that the table in the article on "Patent Office Statistics" in NATURE for September 18, p. 428, contains errors arising from the fact that 'inclusive' salaries and those carrying bonus are shown intermingled in the estimates. The writer of the article has accordingly prepared the following corrected table:

Department.	Total personnel.	Number of personnel with salaries rising to a maximum of		Total of higher posts.	Percentage of higher posts.
		1000*l*. to 1800*l*.	2000*l*. and over		
Treasury	331	17	9	26	7·8
Foreign Office	839	24	3	27	3·2
Ministry of Transport	524	9	2	11	2·1
Board of Trade	567	7	5	12	1·8
Ministry of Agriculture	1197	14	3	17	1·4
Patent Office with Trade Marks and Design Branches	685	4	0	4	0·38

A SHORT manual on First Order Triangulation, by Rev. C. V. Hodgson, forms *Special Publication* No. 120 of the United States Coast and Geodetic Survey. Its purpose is to summarise the methods employed in executing first-order triangulation and base measurement. The Survey now uses the term 'first order' in place of the term 'precise' or its earlier equivalent 'primary.' First order triangulation must have an average triangle closure of about 1″ or less, and a maximum closure not exceeding 3″. The closure in length upon a measured base must not exceed an error of 1/25000. The pamphlet contains chapters on instruments, organisation of parties, routine, sources of error, field computations, and base-line measurement. It is essentially practical, and pays little attention to theoretical considerations.

A CATALOGUE (Dept. No. 3, August) of second-hand books on natural history has reached us from Messrs. W. and G. Foyle, Ltd., 121 Charing Cross Road, W.C.2. It should be seen by readers on the look-out for natural history books, the range being large and the prices low.

DR. C. W. STILES, secretary of the International Commission on Zoological Nomenclature, informs us that a new (English) edition of the International Rules,

together with the summaries of 'Opinions' 1 to 90, has been printed in the *Proceedings of the Biological Society of Washington*, D.C., vol. 39, pp. 75-104, July 1926. Copies can be obtained from Dr. Thomas E. Snyder, the Secretary of the Society (address: Bureau of Entomology, U.S. Dept. of Agriculture, Washington, D.C.), price 1 dollar.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A chemist for research work on the evaporation rates and the ignition temperatures of vapours, of certain inflammable spirits used in industry as solvents, under the Safety in Mines Research Board—The Under-Secretary for Mines, Establishment Branch, Mines Department, Dean Stanley Street, S.W.1. (September 29). A head of the mining department of the Central School of Science and Technology, Stoke-on-Trent—The Clerk to the Governors, Town Hall, Hanley, Stoke-on-Trent (September 30). An assistant for technical records work in connexion with the Department of Scientific and Industrial Research—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (October 4). A senior lecturer in electro-technics at the University of the Witwatersrand—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (October 15). An engineer to take charge of the section of Wood Preservation of the Forest Products Research Laboratory at Princes Risborough—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (December 1). A director of agriculture in the Territory of New Guinea—The Official Secretary for Australia, Australia House, Strand, W.C.2 (December 15). An assistant lecturer in agriculture at the South-Eastern Agricultural College, Wye, Kent—The Secretary. Junior professional assistants in the Meteorological Office—The Secretary, Air Ministry, Adastral House, Kingsway, W.C.2. A senior woman library assistant at the School of Oriental Studies—The Librarian, School of Oriental Studies, Finsbury Circus, E.C.2. A laboratory assistant for the Veterinary Research division of the Agricultural Department of the Government of Kenya—Crown Agents for the Colonies, 4 Millbank, Westminster, S.W.1 (quoting M/14661). A mistress for physics at the Cowley Girls' School, St. Helens—The Secretary to the Governors of the school, 17 Cotham Street, St. Helens

Our Astronomical Column.

RECENT NAKED-EYE SUNSPOTS.—The last naked-eye group of sunspots noted in these columns was No. 9, seen on the sun's central meridian on July 30. Another large group bordering on naked-eye visibility was in transit across the disc between August 10 and 22, but as some observers failed to see it, a number has not been assigned to it in our tabular list of these large spots. Since September 13, however, an important group has been an easy naked-eye object. This new group is composed of two very large spots, both of which could be seen separately through morning fog on September 18. On that day their apparent separation was $3\frac{1}{2}'$, corresponding to $14\frac{1}{2}°$ of solar longitude between their respective centres.

When the spots first appeared round the sun's east limb on September 13, they were evidently of recent origin and growing rapidly, for within 48 hours their total area had doubled. On September 18 the area of the group was 3000 million square miles or 1/400th of the sun's hemisphere. The group ranks accordingly in size with the spot of last December as the second largest group seen as yet this cycle. The region of the sun in which the group occurs is very near that of No. 8, the central meridian passage of which was June 29. During the interval between the disappearance of group No. 8 and the formation of No. 10, the photosphere of that region was marked fairly strongly with faculæ. Particulars of position and area of the August and September spots are given below :

No.	Date on Disc.	Central Meridian Passage.	Latitude.	Area.
—	Aug. 10-22	Aug. 16·2	18° S.	1/1400
10	Sept. 13-25	Sept. 19·5	24° N.	1/400

COMETS.—Two periodic comets, Giacobini-Zinner and Neujmin, are due at perihelion in a few months. The former is interesting from the near approach that its orbit makes to that of the earth. Mr. Cripps has calculated the perturbation and finds December 7 as the date of perihelion. The following ephemeris for 0^h U.T. is from the B.A.A. Handbook :

	R.A.	N. Decl.	log r.	log Δ.
Sept. 30	$16^h\ 50{\cdot}3^m$	7° 15′	0·136	0·144
Oct. 8	17 8·2	5 5	0·115	0·133
„ 16	17 28·5	2 48	0·093	0·120
„ 24	17 51·7	0 25	0·070	0·105

The comet is fairly well placed in the evening sky, being on the meridian about 4 P.M.

THE SPECTRUM OF φ PERSEI.—The results of a detailed photometric study of certain features of the spectrum of the star φ Persei (Sp. type Bope), by Dr. W. J. S. Lockyer, Director of the Norman Lockyer Observatory, are recorded in *Monthly Notices, R.A.S.*, vol. 86, p. 474 (1926) Bright hydrogen lines appear in this spectrum, superposed on broad absorption lines. Each of these bright lines appears double, owing to the superposition of a fine absorption line which undergoes a periodic oscillation, presumably due to a Doppler effect. The two bright components accordingly undergo a periodic change of relative intensity, and the paper records the measurement of this change by the wedge photometer at frequent intervals throughout a complete cycle (Sept. 9, 1925–Jan. 13, 1926). Interesting conclusions are drawn from the measurements, some of which are contrary to what was expected from the observations of other workers. A similar study of the narrow absorption lines of hydrogen confirms an indication of a preliminary investigation that a variation of short period with quite a considerable amplitude is superposed on the primary variation. Pulses of activity are suggested, which seem to increase up to the epoch of maximum negative velocity and decrease down to that of maximum positive velocity. Bright lines of helium and other substances also occur in the spectrum, and the paper includes some comments on their behaviour. The character and intensity of the helium lines suggest a period of variation equal to half that of the primary variation, but the components of the bright ionised metallic lines, although their relative intensities occasionally alter, do not all behave alike, nor do they present any apparent cyclical change.

Research Items.

'SÔMA.'—A note by Prof. G. Jouveau Dubreuil, in the *Indian Antiquary* for September, deals with the identity of the sacred Sôma plant. Dr. Vincent Smith pointed out that while the plant used in the sacrifices of the Parsis of Yezd and Kirmân, as well as of the Deccan and Bombay, is identified with one or other of the species of Asclepias, the real Sôma plant may have been different. Mr. Havell has suggested that it is Eleusine, the common millet still found in the Himalayas. An inquiry has been made as to the plant used by the Sômayagis, who practise the Sôma sacrifice, among the Nambudris, a very high caste of Brahmans in the district of Malabar who, having been sheltered from invasion and change, have thus preserved the Vedic tradition. A reply was received from the great temple of Taliparamba where are the best examples of the *agnidrîvas*—the temples of the Vedic fire—that the Sômavalli plant was a rare plant found in the mountains and was obtained from a raja who lived at Kollangôd (ten miles south of Pâlghât). After some difficulty a specimen of the plant was obtained. It proved to be a climbing plant having a stem which was green, bare, round, and woody, and containing a milky liquor. It is absolutely without foliage, and has been identified as belonging to the genus Asclepias.

ANTIQUITIES FROM KEDAH.—Mr. Ivor H. N. Evans, in the *Journal of the Federated Malay States Museums*, vol. 12, pt. 3, describes the results of a visit to the Langkawi Islands, the neighbourhood of Sungai Patani, Baling, and Weng, to obtain additional examples of antiquities from these localities, and in the last-named place to collect specimens of the manufactures of the Negritos, whose presence had been reported there Excavation work was undertaken on the Sungai Batu estate towards the foot of the Kedah Peak, where an ancient statue, some brickwork, and four worked stones had been obtained in 1921 and 1923. Of these last, two were conduit stones, and another had apparently at some time borne a bas-relief of an elephant-headed god (Ganesha). The excavations revealed the remains of a shrine consisting of wallings of laterite and bricks and, apparently, the sill of a doorway, as well as boulders embedded in a cement of laterite. A number of sculptured stones were found including a highly conventionalised ancient Hindu *Yoni* (female sex organ) apparently of quartzite, a sharpening stone with two depressions for holding the water used in whetting, and two stones with spiral markings, probably the terminals of a balustrade. The conclusion suggested is that the early inhabitants of Sungai Batu were Hindus and worshippers of Siva or related deities. Probably they were non-Malayan traders or miners or, if Malays, they had learnt the art of stone carving from Indian sources. Occupation goes back to a time when stone implements were in use, as is shown by a beautifully made chalcedony celt, and lasted until an ancient Mohammedan settlement. Here also strong Hindu influence is to be observed in four graves of obviously important personages.

INTESTINAL SECRETION OF INSECTS.—In *Memoirs of the College of Science, Kyoto University*, Series B., Vol. 2, No. 2, 1926, Mr. Osamu Shinoda contributes an important paper on this subject. It has long been known that in insects the mid-intestine performs the dual function of digestion and absorption. There exist various theories and hypotheses as to whether these two functions are performed by two distinct kinds of cells or whether they represent different physiological phases of the same kind of cells. Mr. Shinoda's studies were mainly carried out on larvæ of the Saturniid moth *Dictyoploca japonica*. He finds that the epithelial layer is composed of goblet cells and ciliated cylindrical cells which are, in his opinion, homomorphous at different phases of their activity. The cylindrical cells are those in the phases of secretion and absorption, while the goblet cells are nothing more than a resting phase of the cylindrical cells. In the secretory phase the nuclei of the cylindrical cells are large and loosely filled with irregularly shaped basophile granules: the nuclei, it may be added, are situated slightly higher than the middle points of the cells. The cytoplasm just beneath the ciliated border is filled with secretory granules. In the stage of absorption the nuclei lie near the distal ends of the cells; they are small and densely filled with chromatic granules. When the phase of absorption is over the accumulation of secretory granules begins while the nuclei increase in volume and migrate downwards in the cells.

INSECTS AND THE TRANSMISSION OF RINDERPEST.—Very few attempts appear to have been made to transmit rinderpest by the agency of arthropods. Certain bacteriological data obtained by the Director of the Veterinary Research Institute at Muktesar, India, seemed to indicate that the causative organism of rinderpest was possibly not very unlike the Leptospira of yellow fever, which is transmitted from host to host by the mosquito *Ædes argenteus*. This analogy appeared to be worth following up with reference to the possible insect-transmission of rinderpest, and a lengthy paper on this subject has recently appeared in *Memoirs of the Dept. of Agriculture in India*, Vol. 9, No. 5, May 1926. The author, Mr. S. K. Sen, carried out a series of transmission experiments which resolve themselves into three categories. In one series the mosquito *Ædes albopicta* was used as the transmitting agent. The results of the experiments on hill bulls were negative, but some of the rabbits employed showed thermal reactions when infected mosquitoes fed upon them. In another series the possibility of the mechanical transmission of rinderpest through the agency of *Musca domestica* was tested. In a fair proportion of the experiments positive results were obtained when bodies of flies fed upon infective material were inoculated into susceptible bulls. The results, however, were negative when the trials were carried out with reference to transmission under conditions more likely to occur in a state of Nature. The third series was carried out with *Pediculus humanus*. The infectivity of saline suspensions of crushed infested lice was tested upon three bulls, and one of these developed rinderpest. The effects of the transference of infested lice on to a healthy bull, however, were negative.

THE CLIMATE OF NORTH-EAST LAND.—In a paper in the *Geographical Journal* for September on the weather of North-East Land, Spitsbergen, during one month in the summer of 1924, Mr. K. S. Sandford has collected some evidence of value in relation to the problem of glacial anticyclones. In this relatively small but almost entirely ice-covered area he found no fixed anticyclone but a definite tendency towards the establishment of anticyclonic conditions with radial gravitational winds. This intermittent glacial anticyclone is blotted out by interference from outside the area but quickly re-establishes itself. Winds are markedly outflowing and lead to an augmentation of the bordering ice at the expense of the higher parts of the interior. On the other hand, interference from outside is great and leads to melting

of ice in the bordering zone and to a less extent in the interior. During the maintenance of anticyclonic conditions there is some indication of a pulsation, from calm to blizzard. Mr. Sandford believes that in New Friesland, on the mainland of Spitsbergen, there is a similar but modified system. Other parts of Spitsbergen have an insufficient ice-covering for its development. Up to the present there are no winter observations available from North-East Land.

THE NEW MAP OF FRANCE.—The standard map of France is the Carte d'État Major on a scale of 1 to 80,000, from which other scales are derived. So long ago as 1881, on the completion of this map, it was proposed to produce a new coloured map on a scale of 1 to 50,000 In the *Revue Scientifique* (Nos. 12 and 13, 1926) Col. G. Perrier traces the history of these proposals. It was not until 1899 that a specimen sheet of the new map was prepared and then the project was again suspended, eventually to be resumed, but restricted to certain regions in the north-east, east, and south-east for purely military purposes. In 1914 the number of published sheets was only 42. Some provisional sheets for Alsace-Lorraine were produced during the War, and a few for the Saar basin have been since published. But the scheme, which embraces about 1000 sheets, is now definitely suspended owing to expense. Apart from the provisional issues, only 53 sheets are available of this new survey.

THE AGE OF THE EARTH.—In the *Transactions of the New Zealand Institute* (March 6, 1926) the Hon. Sir Frederick Chapman discusses the origin of living organisms and their evolution with the view of reaching a reasonable idea of the period during which the earth has been inhabited. He thinks it is now possible to draw the conclusion that the first organisms were very minute; perhaps far smaller than the typhus bacillus or the invisible microbe of foot-and-mouth disease. Traces of micro-organisms have been found by Walcott in the pre-Cambrian rocks of North America, and from that beginning organisms have become larger and larger up to the massive creatures of the Mesozoic and the 150-ton whales of to-day. The broad question is raised: how many generations are required, and how long would it take, for evolutionary processes, to develop such enormous animals from ancestors of which a thousand million would make up less than a pin's head in bulk? No definite estimate is suggested, for the author recognises that no law of uniformity—either arithmetical or geometrical—can possibly be assumed. Nevertheless, it is made clear that his own sympathies are in favour of the longer estimates of geological time. He rightly protests against the idea that the evolution of the horse within the Cainozoic era could have been accomplished in the four million years that were formerly allowed to that era by certain geologists, then intimidated by the authority of Lord Kelvin. However, this is now of no more than historical interest. It is scarcely likely that Sir Frederick Chapman's problem will ever be directly soluble, even by the integration of its parts. Biologists will probably do better to take their time-scale from the study of geological and radioactive processes, and to make such deductions as to the rate of evolution as may be useful for their purposes. The only direct contribution from palæontology is the broad conclusion that hundreds of millions of years would be preferable to tens of millions.

THE NATURE OF ISOSTASY.—An important paper on isostasy from the pen of Dr. Harold Jeffreys appears in *Gerland's Beitrage zur Geophysik* (Bd. 15, 1926, p. 167). He shows that the work on which the theory of isostasy has been founded is adequate to prove that surface inequalities are compensated at depths of the order of tens of kilometres, but that it fails to provide satisfactory criteria for discriminating between the Pratt and Airy types of compensation or between local and regional compensation. Theoretically there is an infinite number of density distributions which would fit the gravity data, but excluding those that are physically unplausible there is a general likeness between those that are left. The Airy compensation is found to be much the more probable from the point of view of the physical and geological processes involved; and regional compensation spread out to a distance comparable with the depth of compensation as usually inferred is more probable than local compensation. Unfortunately, the depth of the compensating matter and its lateral extent are complementary in the sense that they cannot be disentangled by gravity observations alone. However, regional compensation must be effected at a smaller depth than an equivalent local compensation, and from this consideration it is inferred that the thickness of the granitic layer of the continents must be about half the least value (41 km.) found for the depth of compensation on the local hypothesis. As seismic and thermal evidence suggests a thickness of 15 or 20 km. there is already independent evidence in favour of Jeffrey's conclusions.

TRIETHYLAMINE AND DIETHYLAMINE.—A communication received from the Mellon Institute of Industrial Research, Pittsburg, Pa., states that a new process for manufacturing triethylamine and diethylamine has been developed there by Dr. D. K. Tressler and his assistants. The cost of production of the amines is said to have been considerably reduced, and it is anticipated that they will find extensive industrial applications, many of these being suggested. No details of the method are disclosed.

THE HISTORY OF CHEMISTRY IN AMERICA.—We have received a copy of a paper by E. F. Smith, reprinted from the *Journal of Chemical Education*, Vol. 3, No. 6, June 1926, containing fragments relating to the history of chemistry in America. The six sections refer to such varied subjects as Dr. L. Spalding's "New Nomenclature of Chemistry," 1799; Priestley's visit to America, 1794; alchemists in the New England Colonies, *c.* 1700; mineral analysis, 1824; Amos Eaton's "Chemical Instructor," a very practical text-book, *c.* 1800; and articles from the *Pennsylvania Magazine*, or the *American Monthly*, first published in 1775 by Robert Aitken.

IGNITION OF GASES.—Paper No. 24 (Part 1, by N. S. Walls and R. V. Wheeler; Part 2, by W. Rintoul and A. G. White), published by the Safety in Mines Research Board, describes some of the work being carried out on the ignition of gases. When mixtures of methane and air are exposed to flame, combustion does not take place instantaneously, but an exposure of a definite period is required. The period depends on the character of the flame, being shorter for larger flames. With fully aerated flames, mixtures containing between 9·5 and 10 per cent. of methane are the most readily ignited, but if the flame is not completely aerated and abstracts oxygen from the mixture to which it is exposed, the most readily fired mixtures are those containing an excess of oxygen. When fully oxidised explosives are employed to ignite the mixtures, the optimum methane content is 9·25 per cent., suggesting that the flame of the explosive is not the only factor involved.

Industrial Psychology.

IN the programme of Section J (Psychology) at the Oxford meeting of the British Association, industrial psychology was the subject of several papers and demonstrations of which the following is a brief review:

(1) Mr. R. J. Bartlett, King's College, read a paper on the judgment of value of individual advertisements. The paper arose from an inquiry undertaken by the National Institute of Industrial Psychology three years ago. The first essential of a good advertisement is attracting power and the second holding power. The grading of individual advertisements according to 'attracting-holding' power was taken as the principal task. But in a world as inconstant as that of Paris fashion a 'scale' for measuring this power can have only a temporary value. The scatter of some 180 advertisements when arranged in a scale of 7 grades was found to be normal. Most advertisements fell in the central three grades and very few indeed in grades 1 or 7. For the advertiser the lesson is the old one: 'There's plenty of room at the top.' Another feature is that when the 16 Bovril posters were judged by 15 members of the advertising profession, great variability of judgment from subject to subject was exhibited, yet the resulting order of merit correlated with the winning ballot order as high as $0{\cdot}8 \pm 0{\cdot}1$, showing that there is a common factor in the judgments which is shared by the large population that contributed to the ballot figures.

It was concluded that with a small number of advertisements, up to say 20, the method of paired comparisons, though tedious, is trustworthy. Above that number a fractionation method using 7 groups was recommended. Some practised subjects are even capable of employing this method using 15 groups. Simplicity and unity of design coupled with artistic treatment of shape and balance make for the good advertisement, while overcrowding, distraction from competing foci, and failure to secure the illusion of perspective are among the principal causes of failure In conclusion, two kinds of variability were discussed, namely, the common variability from some nodal value, and that founded on the limited appeal of certain advertisements; for example, pipe smokers agreeing very closely in their disagreements with cigarette smokers. The latter kind is important and deserves further study. This, however, was set aside in forming the present scales, the aim being to assess the value of an advertisement on the assumption that the reader is a prospective purchaser.

(2) Mr. Arthur Stephenson, of the National Institute of Industrial Psychology, read a paper on some observations on accidents in industry. Although one must not belittle the success of mechanical safeguards, yet 90 per cent. of present-day accidents are to be accounted for as failures on the part of the human subject. The U.S. Federal Board for Vocational Education gives many examples of efficient safety work in various industries, but only one-third of the reductions in the personnel sustaining accidents has been effected by mechanical safeguards: two-thirds have been accomplished through organisation and education. Mr. Davis, Secretary of Labour, states that the fatal industrial accidents in the U.S.A. probably exceed 23,000 per annum and non-fatal accidents $2\frac{1}{2}$ millions, and he is advised by experts that 85 per cent. of these are preventable. In Great Britain there are about 1200 fatal accidents per annum in factories and workshops, and another 1200 in coal mines and quarries. Non-fatal accidents of sufficient severity to cause disablement for a week or more number 120,000 a year in factories, and 200,000 a year in coal mines.

The National Institute of Industrial Psychology, so far back as 1922, recommended preliminary surface instruction of youths entering the mine and applied a scheme of training. Mr. Stephenson described an experiment where learners were trained in an industrial process along certain lines. Some of the learners were raw novices while others had had previous experience. Periodical tests of efficiency were made and those who proved incapable of profiting by instructions were discharged. After the scheme had been in operation for 10 months the accident frequency was analysed. The frequency rate for novices dismissed was $1\frac{1}{2}$ times as great as for novices retained, while for experienced learners dismissed it was $3\frac{3}{4}$ times as great as for experienced learners retained. The data obtained made it probable that ability to acquire the neuro-muscular co-ordination required by the particular process, is at least as important a factor as age or experience. Whilst agreeing that a considerable advance may be made by educational and propaganda methods, it is considered probable that the scientific selection of the workers would probably tend to diminish the frequency rate of accidents.

(3) Mr. A. Angles read a paper on restriction of output. In no case within the experience of the National Institute of Industrial Psychology has restriction of output been attributable to the particular trades union as such. It is usually brought about by a strong feeling of class loyalty which, in known cases, has even overcome individual self-interest. Two of the reasons given by workers for this policy are sufficiently frequent to be outstanding:

(*a*) Fear of rate-cutting. Examples are on record where employers have reduced rates in order to keep the workers down to a certain minimum.

(*b*) Fear of unemployment, or increased short-time. The work is spread out so that time-rate workers shall have the benefit of longer hours and more pay. Other reasons are: The fear of discharge of less competent workers, general dissatisfaction with present conditions, influence of the foreman, satisfaction with present earnings. General conditions and systems of wages vary enormously according to the efficiency of the management, but where the 'mental atmosphere' of the factory is good, restriction of output will very rarely be found.

(4) Miss W. Spielman gave a lecture on recent progress in vocational selection. The older methods of vocational selection were compared with modern methods employing mental and physical tests. This lecture served as an introduction to the demonstration given at the conversazione, by Miss Spielman and her assistants, of psychological tests in use at the National Institute of Industrial Psychology. There were tests for vocational guidance (*e.g.* of intelligence, mechanical ability, and manual dexterity); and tests for vocational selection (*e.g.* for engaging weavers, packers, clerks, sales assistants, etc.). In addition, the material collected from various countries by the Research Committee on Vocational Guidance was on view and the various reports of this Committee were distributed to those interested.

(5) Mr. Eric Farmer, investigator to the Industrial Fatigue Research Board, arranged an exhibition, and gave a demonstration at the conversazione, of apparatus designed for the Board by Dr. Schuster, namely, a pursuit-meter, steadiness-meter, a fatigue-inducing apparatus, a dotting apparatus, an original type of chronoscope for serial reactions, and a figure-setting apparatus which serves excellently as a non-verbal test of intelligence. All were original in design and ingenious in workmanship and well calculated to render effective service in the hands of the industrial psychologist.

LL. W. J.

Early Egypt and the Caucasus.

DURING the recent meeting of the British Association at Oxford, the question of the origin and date of the Badarian culture of Egypt was again raised by Sir Flinders Petrie, and provided the material for an animated discussion which, with two closely related papers on the geology and archæology of the Fayum by Miss Gardner and Miss Caton-Thompson respectively, occupied the whole of an afternoon session in Section H (Anthropology).

Sir Flinders Petrie in opening gave a brief summary of the paper which he read before the Section last year at the Southampton meeting. It may perhaps be a convenience to recapitulate here the facts. While working at Badari, a site thirty miles south of Asyut, four seasons ago, members of the British School of Archæology in Egypt discovered a settlement which had in its lowest stratum pottery of a very fine type, entirely hand made, and the thinnest and hardest of any age, with a polish never surpassed. With it were associated ivory statuettes and flints finely worked in technique and form and resembling the Solutrean, and identical with the finely worked flints already known, though from surface finds only, to occur in the Fayum and across the desert up to Palestine. A later investigation by Miss Caton-Thompson produced similar implements from the settlement sites of the Fayum.

Sir Flinders Petrie suggested an Asiatic origin for this culture, its centre possibly being the Caucasus. As regards its dating, basing his conclusions in the levels of the Nile as a time scale, he suggested something like 12,000 to 15,000 B.C. as the period at which the sites had still been uncovered. The chronological evidence was thus, on this reckoning, not contradictory of an attribution of the culture to the Solutrean, following the indication of form and technique in the flint work Obvious difficulties stand in the way of accepting the Badarian culture as an Egyptian offshoot of a Solutrean culture, not the least of course being the presence of pottery. To this the reply is that while one branch of the original Solutrean culture on its migration into Europe along a glacial fringe lost certain elements in that culture, such as the pottery, the other branch, proceeding southward in easier conditions of travel, was able to retain them.

Further, among other criticisms, it has been pointed out that flint working of this delicate type occurs at what is known and admitted to be a later date: it is not to be accepted as being beyond question Solutrean on the ground of its form and technique. In Scandinavia, implements known to be neolithic present a resemblance to the Solutrean form and technique. Sir Flinders Petrie is prepared to accept the facts, but not necessarily as militating against his conclusions. Just as the European Solutrean lost in its way across the Continent, so the south-western branch lost something and degenerated after it had reached Egypt, there was a descent from the finest to the coarsest pottery and from the finest to the coarsest flint work. The recurrence of the finer technique is to be regarded as evidence of a long-continuing Asiatic civilisation which sent off branches from time to time at long intervals.

Apart from the recapitulation and expansion of the argument in favour of the Solutrean date of the Badarian culture, Sir Flinders Petrie brought forward at Oxford two pieces of evidence bearing upon the question of its northern origin, one of which is certainly of first-rate importance if it should be ratified by subsequent examination. Among the finds made by Miss Caton-Thompson in her excavations on the settlement sites of the Fayum during the past season, straw granaries were found buried in the ground which were made of the straw of wheat. This wheat has been pronounced to be neither the old wheat of Babylon and Egypt nor the wheat of Roman times, but a northern wheat. This wheat was certainly unknown in later times, and if the claim that it is of a northern origin can be substantiated, it is a conclusive piece of evidence for, at least, an intrusive element from the north.

The second class of evidence which, in Sir Flinders Petrie's opinion, pointed to a Caucasian origin, was derived from the coincidence between names mentioned in the "Book of the Dead" and certain place-names in the Caucasus. Recently Mr. Fessenden of U.S.A. has advanced the view that in the Caucasus area we are to find the cradle of civilisation, basing his theory upon a multitude of coincidences between Caucasian place-names and names mentioned in legend and tradition. Among others he identified names mentioned in the "Book of the Dead." Sir Flinders Petrie has carried the investigation further. Extracting place-names in the "Book of the Dead" in their local relation to one another, he finds that they equate with place-names in the Caucasus, and, what is more, their local relation corresponds to the correct geographical relation of the equivalent place-names in that area. Further, the mention of a lake of fire in a fertile valley surrounded by barren hills could only correspond in actual fact to the conditions of a naphtha lake in the Caucasus. The traditional origin of Osiris, the god of the corn, in this legendary region is corroborated by the northern origin of the corn now discovered.

It is perhaps scarcely necessary to say that Sir Flinders Petrie's theories found many stern critics, ranging from Prof. Sollas, who pointed out that the conditions of the Badarian culture could not be regarded as corresponding to the conditions of the Solutrean, certainly as regards dating, to Mr. Peake, who, while inclined to accept the northern origin of the culture of the pottery and the grain-growing worshippers of Osiris, not only raised the question as to the equation of Badari and the Fayum, but also in regard to the last argument pointed out the necessity for certainty in the transliteration of the names taken from the "Book of the Dead." Such experts in the technique of flint working as the Abbé Breuil, Dr. Bosch Gimperâ, and Mr. M C Burkitt concurred in thinking that the finely worked flint might be an independently developed Solutrean-like technique entirely African in origin.

It was, however, the papers by Miss Gardiner and Miss Caton-Thompson which most strongly emphasised the difficulties inherent in Sir Flinders Petrie's theories. As already mentioned, he had based his dating of the Badarian culture on the height of the water level. Miss Gardiner's investigations of the recent geology of the Fayum showed that the lake beds north of the Birket Qarun must be divided into at least two series—those of an earlier lake occurring up to 222 ft. above the Birket Qarun level, which were at one time connected with the Nile, as is shown by the fauna, and a later series which only reached the maximum of 205 ft. above the present level. Miss Caton-Thompson's examination of the settlements yielded flint implements of the characteristic type, pottery, and ample evidence of the agricultural, hunting, and fishing culture of the people. It is a characteristic culture of advanced neolithic type. Further, it was found that the sites fringe the shore of the second lake period, resting upon the sands and clays of the old high-level lake. There is

no sign of subsequent submergence. Both topography and the distribution of the high-level gravels emphasise the long period which elapsed between middle palæolithic times and the arrival of the Fayum flint-workers.

It would appear that both the geological evidence and the evidence of culture—unless we are to revise entirely our conception of the culture attainable by a palæolithic people—preclude the attribution of a very high antiquity to this civilisation of the Fayum. In so far it has failed to support the early dating of the analogous culture found at Badari, where too it must be remembered that it has been stated that copper beads were found, not, it is true, in the settlement, but in a grave in the adjacent cemetery.

Animal Breeding and Genetics.[1]

THE report under notice contains the record of a series of most interesting researches, not by any means all of which deal with what may be termed genetical problems, for a considerable number consist in studies of abnormal development. Thus the Director, Dr. F. A. E. Crew, has studied the so-called 'bull-dog calf.' These calves are born dead, and their anatomy shows a close resemblance to the so-called achondroplasia in human dwarfs. Dr. Crew maintains that the tendency to produce such offspring is hereditary and 'mendelises' when crossed with the type. He attributes it to the retardation of the coming into action of the pituitary gland; this may be so, but the immediate mechanism is doubtless as it is in human dwarfs, amniotic pressure, *i.e.* a too closely clinging amnion.

Mr. Nichols investigated a cross between Leicester and Cheviot sheep, the result of which had been stated to produce a hybrid of stable character. When the F_2 generation was raised, however, it was found that whereas 64 out of 103 resembled their F_1 parents, 18 approached the Leicester type and 20 had mixed characteristics of both Cheviot and Leicester. This result does not, as Mr Nichols imagines, prove Mendelian segregation in the proper sense of the word. It is a result always obtained when two natural races are crossed; every conceivable intermediate turns up, but the attempt to express the result in 'factors' leads to interminable confusion. The number examined (100) is far too small to warrant any statistical conclusions.

Mr. Blyth has been engaged in a microscopical survey of the various types of wool raised in the British Islands. Four types are distinguished, namely, mountain long wool, lustre (also long wool), mountain short wool, and short wool (Down breeds). There are two main types of hairs making up the fleeces, namely, (*a*) long coarse hairs with reticular scale markings, and (*b*) short, fine hairs with coronal markings. Type (*a*) is found only in the long wools, type (*b*) in varying proportions in all the breeds. Short coarse fibres called 'Kemp,' frequently shed, are found in all the breeds. This and type (*a*) are regarded as equivalent to the primitive hair of the wild progenitor, whilst type (*b*) represents the original wool.

Mr. Greenwood has been following the fate of grafts of gonads implanted in fowls. This is especially interesting in view of the claim of Zawadovsky to have changed a cock into a hen by two operations, (*a*) cutting out the testes, (*b*) implanting an ovary. Mr. Greenwood finds that the ingrafted ovary frequently assumes a testicular structure by the ingrowth of sex-tubules from its periphery, and that sometimes the removal of the ovary stimulates the development of the vestigial right gonad. This gonad in one case was testicular in structure, in another ovarian, but with ingrowth of sex-cords indicating that it was being transformed into a testis.

Mr. L. Tamura is engaged in investigating the sex dimorphism of the suprarenal gland, which, as a result of previous work, he asserts, is different in the two sexes, the gland of the female showing a wide zona reticularis, whilst this region is vestigial in the male gland. It was found that when the male was castrated the suprarenal underwent enlargement, which was entirely due to the appearance of a wide zona reticularis. A sterile Dingo bitch which was investigated showed an infantile vagina and uterus with degenerating ovaries whilst the teats were normally developed, but not only the suprarenal but also the thyroid and pituitary glands showed obvious and gross signs of degeneration.

In conclusion, we should like to congratulate Dr. Crew on the variety and interest of the researches which are being carried on under his supervision.

E. W. M

[1] Animal Breeding Research Department, the University, Edinburgh. Report of the Director for the year April 12, 1924, to March 31, 1925 (being the Fifth Annual Report). Pp. 21. (Edinburgh.)

University and Educational Intelligence.

THE Brighton Technical College in its calendar for 1926–27 is able to offer substantial evidence of the efficiency of their instruction in engineering subjects, six of the students having gained directly from the College the B.Sc. (Engineering) degree of the University of London in 1926. The College has a flourishing school of pharmacy, and provides courses of building, architecture, commercial subjects, and domestic science, as well as in arts and pure science subjects.

THE Technical College, Bradford, gives particulars in its prospectus for 1926–27 of diploma courses in textile industries, arranged with special reference to the needs of the worsted industry, chemistry, dyeing, civil, mechanical and electrical engineering, physics, and, exceptionally, biology. In recognition of the importance to students in all branches of technology of a knowledge of the fundamental principles of economics, courses in the department of commerce and banking have been developed in relation to those in the various other departments of the College, and particularly to those in the department of textile industries. Conversely, a special course for merchants has been established to equip those students who are to be engaged in the distributive side of the industry with a sufficient knowledge of dyeing and textile subjects.

FROM the Czech Academy of Sciences and Arts, Prague, we have received an 'Almanach" for 1924. It is beautifully printed on 240 pages and is embellished with a large number of remarkably fine portraits accompanying biographical notices It is printed throughout in the Czech language without any summary or abstracts in more widely known languages, and it was with some difficulty that we ascertained the purport of even the title-page. One of the recommendations made by the Directors of National University offices at their recent reunion at Paris was that the official publications of universities should, if printed in a language the use of which is not widely diffused throughout the world, have appended to them abstracts in one of the languages in more general use. The adoption of this recommendation is no doubt impossible in many cases without a certain sacrifice of *amour propre*, but it is

one the practical utility of which is obvious, and the "Almanach" in question is a case in point.

THE London County Council Education Officer has issued a remarkably attractive programme for 1926–27 of lectures and classes for teachers. Ninety-three different courses are offered, each course comprising, in most cases, six or more lectures. They are designed with the admirable objects of bringing London teachers into touch with the latest developments in educational methods and giving them opportunities of hearing leading authorities on questions of national and civic importance. Under the general heading of science are ten courses and four special single lectures. These four are: on eugenics, by Prof. Karl Pearson; production of voice sounds, by Sir Richard Paget; talking by light, by Prof. Rankine, of the Imperial College of Science; and surveying by aerial photography, by Dr. H. H. Thomas, of Cambridge. Among the most valuable of the courses is one on the relationship between science (physics, chemistry, biology, bacteriology, economics) and domestic work, by members of the staff of the Household and Social Science Department, King's College for Women.

THE Royal Technical College, Glasgow, directs attention in its calendar for 1926–27 to the fact that its new building (completed 1910), comprising over seven acres of floor space, forms the largest structure in Great Britain devoted to education. It might also boast that of all institutions included in the University Grants Committee's returns it had in 1924–25 the largest number, 2645, of part-time students, the next largest being the 1926 of the London School of Economics. Among the specialist courses provided by the college which are recognised by the University of Glasgow for attendance by students preparing for the degree of B Sc. in applied chemistry may be mentioned: fuels, dyes and their applications, oils and fats, sugar manufacture, technical bacteriology, metallurgical chemistry, coal tar and intermediate products. The college maintains one of the five principal schools of pharmacy in Great Britain. The Glasgow School of Architecture is under the superintendence of a committee representative of the College and the School of Art. Among the numerous courses in technology not forming parts of degree courses are important series, both day and evening, in textile manufacture.

THE functions of municipal universities are discussed in a paper by George F. Zook, President of the Municipal University of Akron, published in the May number of *School Life*. The paper is concerned chiefly with the question whether municipal universities should continue to regard the traditional four-year curricula as their main business or should develop, alongside of these, one-year, two-year and three-year completion courses of a technical or semi-professional character. It is admitted that the experience of the land-grant colleges in establishing and maintaining one- and two-year curricula in agriculture and mechanic arts has not been very encouraging, but conditions in the municipal universities are very different and they would be failing in their duty to the communities which support them if they did not cater for the requirements of the large number of young people who, after completing their high school course, want to spend less than four years in university studies in preparation for such careers as those of pharmacist, librarian, school teaching, nursing, and the hundred and one occupations lumped under the headings of 'business' and 'industry.' In this connexion it is pointed out that the whole field of evening instruction, both general and technical, is awaiting vigorous development.

Contemporary Birthdays.

September 24, 1874. Prof. Alexander Findlay.
September 26, 1854. Major Percy Alexander MacMahon, F.R.S.
September 28, 1873. Prof. Julian Lowell Coolidge.
October 2, 1875. Prof. Arthur William Conway, F.R.S.
October 2, 1876. Mr. Thomas Sheppard.
October 3, 1858. Prof. Percy Faraday Frankland, C.B.E., F.R.S.

Prof. FINDLAY, occupant of the chair of chemistry in the University of Aberdeen since 1919, was educated at that city's grammar school, proceeding afterwards to the University there, and to the University of Leipzig. Early he was a research student in University College, London, whilst from 1902 until 1911 he held a lectureship in chemistry in the University of Birmingham, leaving to take up a professorship in science at University College, Aberystwyth. He has published several books, among them being a stimulating volume entitled "Chemistry in the Service of Man."

Major MACMAHON (Royal Artillery, retired), late Deputy Warden of the Standards, Board of Trade, was born at Malta. He was educated at Cheltenham College, passing thence into the Royal Military Academy, Woolwich, where later (1882–88) he was instructor in mathematics. The Royal Society awarded him a Royal medal in 1900 on the ground of the number and range of his contributions to science in the department of pure mathematics. Further recognition by the Society came with the allotment of the Sylvester medal to Major MacMahon for studies in the partition of numbers. General secretary of the British Association from 1902 until 1914, he is a past president of the London Mathematical Society.

Prof. J. L. COOLIDGE, mathematician, was born at Brookline, Mass., U.S.A. A graduate of Harvard, he also studied at the Universities of Oxford and Bonn. He has been successively instructor in mathematics, assistant professor, and, from 1918, professor in that subject at Harvard. Prof. Coolidge is an Officer of the Legion of Honour. He is the author of "Elements of Non-Euclidean Geometry" (1909), and "Geometry of the Complex Domain" (1924).

Prof. CONWAY, registrar and professor of mathematical physics in University College, Dublin, was born at Wexford. He was educated at Dublin and Corpus Christi College, Oxford.

Mr. THOMAS SHEPPARD, the zealous director of the Hull Museum, was born at South Ferriby, Lincolnshire. He has long rendered sterling service as editor of various Yorkshire society publications relating to natural history, numismatics, geology and archæology. Mr. Sheppard is the author of "Yorkshire's Contribution to Science" (1915).

Prof. PERCY FRANKLAND is a Londoner. He was educated at University College School, the Royal School of Mines, and the University of Würzburg. From 1888 until 1894 he was occupant of the chair of chemistry in University College, Dundee, leaving there to take up a similar post in Mason College, Birmingham, continued also in its University. He was president of the Institute of Chemistry in 1906, and of the Chemical Society in 1911. Prof. Frankland was awarded the Davy medal of the Royal Society in 1919 for distinguished work in chemistry, especially on optical activity, and on fermentation.

Societies and Academies.

LONDON.

The Institute of Metals (Liége meeting), September 2.—L. **Boscheron**: An account of the non-ferrous metals industry in the Liége district. An historical account is given of the development of the zinc industry of the Liége district, with particular reference to the discovery of the distillation process by Dony and the subsequent improvement and application of this process. The absence of water-power and the high cost of electrical energy in Belgium renders the new electrothermic and electrolytic methods of manufacture of zinc inapplicable in Belgium. The discovery of a method of continuous production would be welcomed.—A. G. C. **Gwyer** and H. W. L. **Phillips**: The constitution and structure of the commercial aluminium-silicon alloys, with an appendix by D. **Stockdale** and I. **Wilkinson** upon the properties of the modified aluminium-silicon alloys. The investigation deals with the constitution, structure, and mechanical properties of modified aluminium-silicon alloys, and a theory based upon colloidal lines is put forward to explain the nature of the modified structures. The alloys possess good founding qualities; are appreciably lighter than pure aluminium, and in both chill- and sand-cast states possess a high resistance to shock, excellent ductility, and a high degree of incorrodibility.—J. D. **Grogan**: Some mechanical properties of silicon-aluminium alloys The sodium and 'salts' methods of modifying these alloys are described. The 'salts' method is preferred. Ternary alloys containing also magnesium or zinc are not superior to the binary alloys.—Buntaro **Otani**: Silumin and its structure The chief development of aluminium-silicon alloys during the last three years has been in the direction of a marked increase in mechanical properties, due to the modifying action caused by the addition of metallic sodium or alkali fluoride to the molten alloy. The present paper puts forward a theory to explain the process of modification.—H. J. **Gough**, S. J. **Wright**, and D. **Hanson**: Some further experiments on the behaviour of single crystals of aluminium under reversed tortional stresses. The resulting distortion under this complex type of straining action is observed using slip-band measurements, and is related to the atomic orientation of the crystals by means of X-ray analysis The complicated system of slip-bands observed is in agreement with the simple law that slip is confined at any point of the surface of the crystal to one of the octahedral planes and in the direction of the most highly stressed (shear stress) principal lines of atoms. The progressive hardening during a long endurance test has been studied.—P. **Chevenard**: Thermal anomalies of certain solid solutions. Certain feebly magnetic solid solutions show transformations which are similar to those of ferromagnetic substances in that they occur without change of phase (that is, change of space lattice), they are spread out over a large range of temperature, they are subject to relatively slight hysteresis, and result in anomalies in the different physical properties, dilatation, specific heat, resistivity, thermo-electric power, etc. They differ from the magnetic transformations in that the temperature of their occurrence does not vary with change of composition. Evidence is given of the existence of these so-called 'X' transformations in copper-aluminium, nickel-chromium, and copper-nickel solid solutions, and a detailed study is made of their effect on the dilatation of the first two groups of alloys and on the resistivity of the last.—W. T. **Cook** and W. R. D. **Jones**: Preliminary experiments on the copper-magnesium alloys. The chief feature is the production of sound chill-cast bars free from smooth-sided internal gas cavities by means of a double-melting process similar to that recently recommended by Archbutt for the production of castings in aluminium free from pinholes. Details are given of the method adopted of a type of bottom-pouring crucible used to eliminate inclusions of flux and slag.—Kotaro **Honda**: A comparison of static and dynamic tensile and notched-bar tests. Machines for testing materials have recently considerably increased in number; for example, referring to the methods of testing, there are the following tests: tension, bending, torsion, toughness, fatigue, abrasion, hardness, and single and repeated impact tests, etc. Since for each of these tests we have several types of machines, it is of importance to study the merits and demerits of these machines and to make a selection of those which are best for the purpose.

September 3.—C. J. **Smithells**, H. P. **Rooksby**, and W. R. **Pitkin**: The deformation of tungsten crystals. When metals are rolled or drawn the crystal fragments tend to take up a definite orientation with respect to the direction of working; the same effect is produced during the swaging of tungsten rods. The micro-structure and X-ray diffraction pattern at various stages of the swaging have been examined with the view of learning the mechanism by which this preferred orientation is attained.—A. **Pinkerton** and W. H. **Tait**: Season-cracking in arsenical tubes. While severely hollow sunk tubes made from arsenic-free, deoxidised copper are not liable to season-cracking, tubes made from arsenical copper, according to the British Engineering Standard specification, are liable to season-cracking when made under certain conditions. The temperature at which annealing renders such tubes immune from season-cracking has also been determined.—Cyril S. **Smith** and C. R. **Hayward**: The action of hydrogen on hot solid copper. When copper (wire) containing oxygen is heated in hydrogen, maximum brittleness is obtained at intermediate temperatures, and a marked recovery occurs when the action is carried out at temperatures approaching the melting-point. The rate of penetration of hydrogen into cast copper has been determined and certain peculiarities observed. When the oxygen in the copper exceeds 0·07 per cent the depth of penetration in a given time is greater at about 800° C. than at higher temperatures When brittle gassed copper is annealed and forged in a non-oxidising atmosphere, the cracks responsible for the brittleness close, and metal of remarkable properties is obtained.—Francis W. **Rowe**: Bronze worm-gear blanks produced by centrifugal casting.—Kathleen E. **Bingham**: The constitution and age-hardening of some ternary and quaternary alloys of aluminium containing nickel. This investigation is part of a scheme of research on aluminium alloys which has been in progress in the Metallurgy Department of the National Physical Laboratory, under the direction of Dr. W Rosenhain. The first part deals with the age-hardening of some of the ternary alloys of copper, nickel, and aluminium; and the second with the constitution and age-hardening of similar alloys, with the addition of small percentages of magnesium.—Captain F. R. **Barton**: Development of the use of nickel in coinage. In its pure form, and also as a constituent of binary alloys, nickel has been widely adopted during the last half-century as a coinage metal. Experience shows that pure nickel coins wear longer in circulation than those made of silver, and that they were equally proof against counterfeiture.—C. H M. **Jenkins**: The constitution and the physical properties of the alloys of

cadmium and zinc. The constitution and properties of the zinc-rich alloys seem to be considerably influenced by the two polymorphic changes which appear to exist in zinc. One of these changes caused an increase in the solid solubility of cadmium in zinc above the eutectic temperature; the resulting equilibrium diagram is therefore somewhat unusual, containing a region representing a completely solid alloy occurring above an area which is composed of both liquid and solid alloys. The cold-worked alloys very slowly soften at room temperature, but the effect of ageing does not cause any unfavourable alteration. The zinc-rich alloys should not, however, be annealed after this ageing. The properties of cast and rolled zinc are improved by the addition of cadmium. The eutectic alloy previously proposed for use as a medium hard solder possesses very suitable physical properties for this purpose.—G. B. **Phillips**: The primitive copper industry of America (Pt. 2). Many thousands of copper objects have been investigated; they show a somewhat sporadic industry, but considerable mechanical skill and artistic taste in their manufacture with stone and bone tools by the aborigines. Analysis indicates the source of the metal to be the native copper from the mines of northern Michigan and not copper brought from Europe.

PARIS.

Academy of Sciences, August 23.—**Bigourdan**: A means of verifying the uniformity of the earth's rotation.—A. **Bigot**: The Bathonian of Chailloué (Orne).—Jacques **Chokhatte**: Some applications of the polynomials of Tchebycheff with several variables.—N. **Stoyko**: The precision of time of the rhythmic signals of the Bureau International de l'Heure.—Louis de **Broglie**: The possibility of connecting the phenomena of interference and diffraction with the quantum theory of light.—J. **Cayrel**: Double detection with galena and chalcosine. The generality of the phenomenon.—Robert **Régnier** and Roger **Pussard**: The conditions under which the disease communicated to field mice by the Danysz virus is propagated.—E. P. **Fortin**: Histological investigations on certain elements of the retina.—P. **Wintrebert** and Yung **Ko-Ching**: The protoplasmic contraction of the early embryonic forms in *Gasterosteus aculeatus* and *Pygosteus pungitius*.—E. **Iwanow**: Time of persistence of the fertilising property of the spermatozoids of mammals in the epididymus separated from the organism.—L. **Nattan-Larrier, G. Ramon,** and E. **Grasset**: Antitetanus immunity in the newly-born.

CAPE TOWN.

Royal Society of South Africa, July 21.—J. Smeath **Thomas**: The action of sulphur chloride on mercaptan—the existence of diethyl-tetrasulphide. The author has previously shown that in the case of the alkali metals the maximum number of S atoms that can be introduced into the polysulphide molecule increases with increasing electro-positivity of the metal, that in the polysulphide series some members are of greater stability than others, and that only these more stable compounds are obtained by ordinary laboratory methods of preparation. In every case the disulphide is stable, but the composition of the higher stable compound varies; the more electropositive the metal the greater the number of S atoms in the molecule of the higher stable polysulphide. An extension of the work to organic polysulphides led to a similar conclusion. Here again the disulphides are always stable and the higher stable polysulphide, in the case of the alkyl compounds, seems to be the pentasulphide. Thus both sodium *tetrasulphide* and potassium pentasulphide on treatment with ethyl iodide yield diethyl pentasulphide mixed with a little disulphide.—W. A. **Jolly**: On the rhythmical functions of the spinal cord. The author discussed the oscillations which appear on the electromyograms in reflexes and the intraspinal delays, and pointed out the relation which subsists between the time intervals in the two phenomena.—J. **Moir**: Colour and chemical constitution, Part xxii.—A study of methyl derivatives of the phenolphthaleins. Nearly all the methyl derivations of phenolphthalein (ordinary and orthopara) have been examined. The effect of all substitutions on colour is additive, each item acting independently.

SYDNEY.

Royal Society of New South Wales, August 4.—R. H. **Cambage**: Acacia seedlings. Part xii. The seedlings are described of the following ten species: *Acacia binervosa*, *A. Burkittii*, *A. Cambagei*, *A. Cuthbertsoni*, *A. latipes*, *A. leptoclada*, *A. pruinosa*, *A. restiacea*, *A. rupicola*, *A. salicina*. In regard to the vitality of Acacia seeds in the soil, it is recorded in the paper that 200 seedlings of *Acacia mollissima* sprang up immediately after the ploughing of an area of four acres which had not been cultivated and on which Acacia trees had not grown for sixty years. In a second case, six acres of grass land had been enclosed and ploughed. No Acacia trees had grown on the area since it was cultivated sixty-eight years before, although some were growing a quarter of a mile away, but after the land had been ploughed, more than 1000 seedlings sprang up on one particular acre of the enclosed area, evidently at a spot where many trees of the same species formerly grew.—A. R. **Penfold**: The essential oil of *Zieria macrophylla* (Bonpland), and the presence of a new cyclic ketone. The leaves and terminal branchlets yield from 0·3 to 0·66 per cent. of a brownish coloured oil of peculiar odour. The following constituents have been identified: d-limonene (10-20 per cent.), a new cyclic ketone, $C_{13}H_{20}O$, about 50-60 per cent. (called zierone), together with sesquiterpene, sesquiterpene alcohol, amyl alcohol, a low boiling isovalerianic ester, etc.—F. R. **Morrison**: The fixed oil of the kidney fat of the emu. The oil, which was yellow in colour, had an odour resembling mutton fat, and was of a soft buttery consistency during the winter months. The oil consisted of the glycerides of oleic, linolenic, palmitic and stearic acids The occurrence of linolenic acid is of interest, this acid being rarely found in animal oils.—A **Grady** and H. **Hogbin**: Mountain lagoon and the Kurrajong fault. Mountain lagoon is apparently formed by the damming up of a small stream by the rising Kurrajong fault. The lagoon is a topographic feature which will soon disappear, for creeks, on all sides, have cut back by headward erosion, almost to the lagoon itself.

Official Publications Received.

The Journal of the Institute of Metals. Edited by G. Shaw Scott. Vol. 35, No. 1, 1926. Pp. xii+988. (London: Institute of Metals.) 31s. 6d. net.

State of Illinois. Department of Registration and Education: Division of the Natural History Survey. Vol. 16, Article 1: Third Report on a Forest Survey of Illinois. By Clarence J. Telford Pp. iv+102+4 maps. (Urbana, Ill.)

Department of the Interior: U.S. Geological Survey. Bulletin 779: Guide to Ore in the Leadville District, Colorado. By G. F. Laughlin. (Washington, D.C.: Government Printing Office.)

Smithsonian Institution: United States National Museum. Report on the Progress and Condition of the United States National Museum for the Year ended June 30, 1925. (Washington, D.C.: Government Printing Office.)

of potash is very localised, but the deposits are enormous, Germany and the Upper Rhine being estimated to contain no less than 21,000 million tons of crude potash salts situated at workable depths. Phosphate deposits are more numerous, although the life of the most important of them has been estimated at from twenty-one to seventy years; there are, however, vast deposits that are poor in grade or badly situated. Apart from the Chilean nitrate-beds, which have a definitely limited life, and the wonder-workings of the nitrogen-fixing bacteria, the world is ill-supplied with natural nitrogenous fertilisers, but the chief raw material of these fertilisers—nitrogen—is extraordinarily abundant: no less than eight tons of it are present in the air over every square metre of the earth's crust; and few human achievements can compare in importance with the recent work of physical chemists in making this mine of potential fertility available for agricultural purposes.

To Germany belongs most of the credit for having elaborated the manufacture of synthetic nitrogenous fertilisers by means of the Haber process. That process, together with the modifications due to Claude, Casale, and Fauser, consists in uniting nitrogen from the air with hydrogen from water to form ammonia; and to-day it is by far the most important of nitrogen-fixation methods, the cyanamide process coming next and the arc process third. The estimated production of combined nitrogen in Germany during the fertiliser year 1925–26 (June-May) was 600,000 metric tons (equal to nearly 3 million tons of sulphate of ammonia), of which 90 per cent. was to be made by synthetic processes. Although the Haber and cyanamide processes were much used in Germany during the War, it was not until 1923–24 that Germany had sufficiently recovered from its effects to be able to export nitrogenous fertilisers; for the year 1925–26 her estimated exports were about 135,000 tons of fixed nitrogen, equivalent to about 675,000 tons of sulphate of ammonia. Following Germany's lead, the manufacture of synthetic ammonia has been taken up in many lands, and although, in general, achievements have not so far corresponded with effort and *réclame*, there is no doubt that within the next decade production will attain a figure undreamed of before the year 1914. It is satisfactory to note that, next to Germany, Great Britain is the most important producer of synthetic nitrogen compounds, an achievement that is due to the initiative and enterprise of Messrs. Brunner, Mond and Co., Ltd., through its associated company, Synthetic Ammonia and Nitrates, Ltd.

The future of the British nitrogen industry, its ability to retain the home market and to withstand foreign competition in the outlying parts of the Empire, are matters of national concern, not only in respect of the peace-time manufacture of fertilisers, but also in respect of the war-time production of nitric acid and high explosives. In Great Britain the chief source of supply of manufactured nitrogenous fertilisers has long been, and is still, the ammonia that is obtained from coal as a by-product in the manufacture of metallurgical coke and town's gas. This ammonia is converted into ammonium sulphate, which is still the most popular of manufactured nitrogenous fertilisers, and of which very large quantities are sold at home and abroad. Our total production of nitrogen as ammonium sulphate in the year 1925–26 was 429,517 tons, of which 238,611 tons was exported. Exports and prices, however, are falling as the result of severe German competition, and the outlook is not cheerful. At the recent International Conference on Nitrogen Propaganda in Biarritz, it was stated that the British Sulphate of Ammonia Federation, of which Synthetic Ammonia and Nitrates, Ltd., is a member, had made an arrangement with the German Nitrogen Syndicate by which new German nitrogen compounds that are suitable to English conditions would be made available to English farmers; but nothing in the nature of a *quid pro quo* was mentioned. Now the Germans are very active in producing new fertilisers, which play an important part in their propaganda.

Dr. J. Bueb told the conference at Biarritz that when Germans enter a foreign market they are very careful to 'push' only well-known fertilisers until they have obtained a firm foothold; then they introduce their novelties, usually mixed fertilisers, that are especially suitable to the local conditions. In 1919–20 it was recognised in Germany that ammoniacal nitrogen could never completely replace nitric nitrogen (as in Chile saltpetre); and the hygroscopic and explosive ammonium nitrate being regarded as unsuitable, efforts were concentrated on producing mixed fertilisers like ammonium sulphate-nitrate and ammonium-potassium nitrate. To compete with Chilean nitrate, a white calcium nitrate of the same nitrogen content, but without its bad effect on 'sticky' soils, has been successfully marketed. In 1924 the manufacture of urea was started on a large scale, and this highly concentrated fertiliser (46 per cent. nitrogen) is selling very well, being especially valuable for tobacco, hops, vine, garden plants, meadows and pastures. Pure di-ammoniumhydrogen phosphate ('Diammonphos'), and a mixture of it with ammonium sulphate ('Leunaphos'), are among the chief products of the well-known 'Badische' company; whilst a compound fertiliser containing nitrogen, phosphoric acid, and potash in the ratio 1 : 0·75 : 1 has been specially worked out for sale in China under the name of 'Leunaphosphate.' Variety of form, low price, and intensive

propaganda are the outstanding features of the rapidly expanding German trade in fertilisers.

With regard to the security of the British home market, it appears highly probable that Synthetic Ammonia and Nitrates, Ltd., will come to an arrangement with the German Nitrogen Syndicate whereby spheres of influence will be defined and selling prices will be fixed and adjusted in ways advantageous to both. Failing the conclusion of such an arrangement, or in the event of its future collapse if made, competitive ability will depend upon quality, manner of marketing, production costs, selling policy and salesmanship. On the score of quality we need entertain no fear. British goods are not always best, as the Government post-mark asserts (though they may be always the best to buy), but in the case of chemical products made by a firm of the standing of Brunner, Mond and Co. there is no doubt that they can hold their own against all comers. In the matter of producing costs there is much less certainty. The cost of labour and fuel, together with paralysing taxation, constitute at present enormous handicaps to cheap production; and it is unlikely that any Government would succeed in restricting foreign competition under the provisions of the Safeguarding of Industries Act. On the other hand, it is understood that Synthetic Ammonia and Nitrates, Ltd., has effected a number of improvements and economies in the Haber process; it commands a personnel, financial and administrative as well as technical, that is second to none; and it has ample capital resources.

Competition at home is not to be feared, for synthetic nitrogen compounds will be produced at a cost which, in the event of unrestricted competition, would oust by-product ammonium compounds from the market. Both coke-ovens and gas-works will have to toe the line set by the nitrogen factory. The gas companies will continue to produce sulphate of ammonia, because they will not be allowed to turn their poisonous gas-liquor into streams and estuaries; and what they lose on the swings of ammonia they will make up on the roundabouts of gas and other residuals. Coke-oven works will suffer an important loss of revenue, so that the price of metallurgical coke may rise, and with it the prices of iron and steel. The home industry will therefore be able to present a solid front to the foreigners who would invade the home market; but if that market is to be preserved, producing costs must be kept low by all possible means; and if labour is refractory we must cheapen overhead costs by extending sales, the possibilities of which are very considerable. The recent appointment by Synthetic Ammonia and Nitrates, Ltd., of Sir Frederick Keeble to take charge of research into the application of synthetic nitrogenous compounds to agricultural purposes, and to be director of propaganda, is of especial significance, for it shows that the company is fully aware of the possibilities of the application of science and scientific method to the problems of industry, and of the value of trained experience in organising propaganda among potential consumers.

Among the more promising new outlets for nitrogenous fertilisers is their application to meadow and pasture land. In the past only arable land has been fertilised in this manner, but three years ago the German manufacturers initiated a series of large-scale tests on the use of nitrogen, with or without phosphates, for grass-land, and the results have shown that the treatment is economically profitable, provided that due regard is had to the nature of the soil and the vegetation, although the increased returns are lower than in the case of arable land. The capital cost of this extension to farming practice would undoubtedly put an additional burden on the small farmer, but the constantly diminishing price of combined nitrogen, and the increasing cost of artificial feeding-stuffs, are factors that should encourage him to undertake the risk. Another possibility lies in the breeding of new types of the most important species of cultivated plants that will assimilate much larger quantities of nitrogen than existing types, and so yield much bigger crops from the same acreage. Such an achievement is held to be quite feasible, although many years may elapse before it is consummated. Further progress would result from the devising of means to retain in the soil the nitrogen that is applied to it in the form of nitrogenous fertilisers and manures. Sir John Russell estimates that under good farming conditions only about one-half of the applied nitrogen is recovered in the first year's crop, and but very little of the residual nitrogen in later crops. Such an economy would at first sight appear to be disadvantageous to the manufacturer, but the farmer would be able to extend his purchases of fertiliser and bring under intensive cultivation land which could not previously stand the cost of artificial dressings.

Quite apart, however, from novel developments of the above kind, there is no doubt that the field of consumption of nitrogenous fertilisers is capable of almost unlimited extension. Russia, Argentina, Canada, Australia, and South Africa are practically virgin fields for the use of manufactured fertilisers, whilst of all the countries that already use them, only Germany, the United States, France, Great Britain, Holland, and Italy are important consumers. The order for consumption of fertilisers of all kinds is that given; for nitrogenous fertilisers only, it is Germany (easily first), the United States, France, Great Britain, Holland, Italy, and Egypt. A better view of the present position is, however, obtained by considering the

consumption per unit area of cultivated land. From the statistics published by the International Institute of Agriculture at Rome for nitrogen consumption in the fertiliser year 1921–22, it is seen that Holland comes first, followed closely by Germany, and then at a long interval come Egypt, Belgium, Great Britain, Japan, France, and Sweden, whilst the United States and Canada rank very low indeed.

When we consider that intensity of cultivation differs very greatly in these countries, and that experts in Germany maintain that her soil would respond to twice the quantity of fertilisers which are now applied, we obtain some idea of the great possibilities in store. There is big business in fertilisers to-day ; there will be bigger business to-morrow ; and no progressive country will be able to afford to neglect provision of these basic raw materials of food production. With expansion of the world's demand for them, we may expect the chemical industry to occupy a more prominent place in the industrial world than it does to-day, and even the chemist may receive that meed of recognition for which he has been striving so long. In Germany to-day it is openly said that the I.G.- the enormous combine of chemical manufacturers—*is* the Government.

If Great Britain is to hold her own in the world's markets, better men must be attracted to the profession and industry of chemistry by offering more adequate rewards; and salesmanship and propaganda, which are playing an increasingly important part in mundane affairs, must not be neglected. We must abandon the attitude of 'take it or leave it,' and study actual demands, local conditions, and the psychology of our customers. The farmer is proverbially one of the 'toughest nuts to crack.' Conservative by nature, he is also frequently regarded as simple. In reality he is very astute, although his time-reactions are slow. He is also suspicious, as he has good reason to be, because of his past experience of quack wares and of good wares sold at extortionate prices. He is apt to regard the adjective 'chemical' with grave suspicion : did not his forbears denounce nitrate of soda as 'the scourge'? He is also more resistant than the average town-dweller to the lure of printed advertisements ; but he is not impervious to the advances of the well-qualified agricultural lecturer, and still less to the evidence of the demonstration plot. What does appeal to him strongly is the success of a neighbour or a rival in obtaining yields and results which he has been unable to achieve; and, of course, he is very susceptible to the argument of *l. s. d.*; in other words, he should be approached through his primary instincts of positive self-feeling and acquisition. In this respect he is not markedly different from the rest of us ; as Goethe said, "Mankind progresses, but man remains the same."

Peasant and Pundit in India.

Bihar Peasant Life: being a Discursive Catalogue of the Surroundings of the People of that Province. By Sir George A. Grierson. (Prepared (in 1885) under Orders of the Government of Bengal.) Second and revised edition. Pp. iv + 4 + 443 + xvii + clv + 40 plates. (Patna: Government Printing Office, 1926.) 10 rupees.

BIHAR, the homeland of Buddhism, came under the East India Company in 1765, and remained merged in Bengal until 1912, when it reappeared as senior partner in the new province of Bihar and Orissa. In area Bihar is larger than Hungary; its population (nearly 600 to the square mile) is greater than that of Canada, Australia, and the Union of South Africa combined. Of its people, only 8 per cent. live in towns, a fact not easy for the 80-per-cent.-urbanised Englishman to appreciate.

The Bihari peasant is reputed boorish, but a certain young civilian who landed in India in 1873 found him well worth study. There is only one way to get to know a peasant, and that is by talking to him. His language is not the language of poets and pundits, nor can it be learned from a dictionary, for many of its concepts have no equivalents in English and many of its words are as strange to literature as 'zoles' and 'spitters' (unless he come from Devon) to the average professor of classical Greek. So it was that one of the most masterly linguists of the age became the peasant's pupil; "every word in this book," writes the author, "has been collected from the mouths of the people" The task took seven years.

The plan of the book is modelled on a work by the late Dr. Crooke. It is a pity that the lead was not followed in every province of India; for a better key to the life and mind of the ryot could not be proffered to the new-fledged civilian.

Sir George Grierson describes his book as a "discursive catalogue." It is more than that; for, though intended only as a foundation for serious research, it throws in vivid relief the things that count in Indian peasant life. Its main interest centres, of course, in the land; the rich belt nearest the home, the leaner belt on the village outskirts, and the belt between; land new made and land washed away by the vagaries of rivers; soils sandy, clayey, loamy, saline, or stony; soils water-logged and soils which will not retain moisture; the ploughing and reploughing—"a hundred ploughings for cane, fifty for wheat," as they say in Gaya—the sowing, transplanting, irrigating, weeding, and watching; and then the harvest, and the division of the crops between landlord

and tenant; the deductions and remissions, and the perquisites due to the village carpenter and blacksmith, the weaver and shoemaker, the sweeper, the accountant, the weighman, and the watchman; a tough business was this settlement of grain rents, by custom and without contract, and the variety of tenures is bewildering. Then there is the problem of labour; the serf who cannot leave his job, or marry, or do anything without his lord's consent; the debtor who binds himself to work until his debt is cleared; the one-year servant and the half-day servant; the man who, in lieu of wages, borrows a plough and oxen one day in three; the pair of cultivators who join and till each other's land in turn; and, in the background, advances of grain and cash, and loans and mortgages on terms unthinkable in generous England.

Other sides of peasant life there are, subsidiary always to the land; the live stock, the home life, the cottage industries. It would puzzle a lexicographer to discriminate in English between the 140 odd varieties of earthenware vessels named (the list is not exhaustive), let alone vessels of metal, wood, or leather, baskets, boxes, and nets, the 100 or so different kinds of jewelry, or the 250 or more different kinds of food.

Of domestic ceremonies, the rites of birth, marriage, and death, the treatment is necessarily cursory; such subjects can only be dealt with adequately by an intensive study of each separate community, for in no two castes are they exactly alike. The same applies to religion generally, for each cult requires separate handling, and more than a hundred cults are named.

The list of country craftsmen, so unlike anything European, shows how little the simple self-contained culture of the Indian peasant is dependent on Western industrialism. Of local products, the only one of industrial importance was (before German chemistry strangled it) indigo.

In mechanics, the Bihari shares with the rest of India the oil-mill and the water-lift, but his masterpiece of ingenuity is the two-wheeled 'large complete country cart,' in which the art of adjusting strains and stresses seems to run riot; the why and wherefore of its three pairs of intersecting spokes, which run from felloe to felloe, its twin axles, one for each wheel, and its 'spinal curvature,' deserve an expert monograph.

Needless to say, Sir George Grierson is scrupulous to observe the niceties of scientific writing, the neglect of which too often impairs the value of books on India. He is careful to define his geographical units, and to explain them with a map; each vernacular word is printed twice, once in the vernacular script, and again transliterated in italics; and, a point most necessary in a land of more than 200 languages, plants are given their botanical names, though the terms used are sometimes out-of-date and generic names seldom begin with capitals. To question Sir George's accuracy would be presumptuous, but (p. 401) Bakr-Id does not always fall in December or Barah-Wafat in March; these festivals, like the rest of the Moslem calendar, fall a little earlier year by year.

Events in India in recent years have somewhat obscured the ryot's interests, and the timely reissue of this valuable work is to the credit of the Bihar and Orissa Government. But in 'get up' this second edition is a sorry travesty of its former self. The first edition was neatly printed on excellent paper, smartly bound and lettered, and beautifully illustrated. In the new volume the paper is coarse, the binding clumsy, the printing dirty and irregular, the pictures blurred; while the errata list covers 29 printed pages and yet records but a fraction of the misprints which disfigure almost every page of the text, making it everywhere untrustworthy, and sometimes unintelligible. Such being the case, it is not a little surprising to read in the 'Foreword' that the proof-reading was entrusted to two distinguished officers who are thanked by the Government "for the care they have taken to produce an accurate reprint."

F. J. R.

Wilhelm Hofmeister.

Wilhelm Hofmeister: the Work and Life of a Nineteenth Century Botanist By Prof. Dr. K. von Goebel. With Biographical Supplement by Frau Professor Ganzenmüller. Translated into English by H. M. Bower, and edited botanically by Prof. F. O. Bower. (Ray Society Volume (No. 111) for 1925.) Pp. xi + 202. (London: Dulau and Co., Ltd., 1926.) 12*s*. 6*d*. net.

THE Ray Society has just published a translation into English of a volume which appeared in Leipzig in 1924 to celebrate the centenary of the birth of Wilhelm Hofmeister, a botanist to whom is generally assigned the premier place in plant-morphology during the nineteenth century. This version follows as a fitting sequel to the volume of Hofmeister's researches published in English in 1862 by the same Society under the title "On the Germination, Development and Fructification of the Higher Cryptogamia, and on the Fructification of the Coniferæ," which for more than sixty years has been held as a classic by all English-speaking students of plant-morphology. The volume last named was, however, not merely a translation of works already published by him in German: its

text was specially revised and enlarged by the author himself for the Ray Society, so as to be a complete record of all known at that time on the subject to which it related. Thus on two occasions, far apart in date, the Ray Society has promoted the interest of botany by presenting in English works concerned with the same great discoverer.

The centenary volume was written by Hofmeister's most distinguished living pupil, Dr. K. von Goebel, now professor of botany in Munich: a man whose outstanding position in science has recently been recognised afresh by his election as foreign member of the Royal Society of London. He is the heir to Hofmeister's dominant place, not only as a formal morphologist but also as a philosophical biologist. This union of the study of form and function has indeed been stereotyped by the title given by von Goebel to his own great work. "Organographie."

Botanists, and biologists generally, recognise in Hofmeister the exponent of alternation of generations in plants. They admire his keen and unswerving perception of the homologies of those successive phases which in divers plants are so often disguised by differences of form and proportion. He first disclosed, in 1851, that underlying cycle of events which normally characterises Archegoniate plants, including the Coniferæ. The similarity of the constant cycle in them all was indeed shown to be so close that when Darwin's "Origin of Species" was published, the common underlying plan appeared at once to gain evolutionary significance.

Hofmeister's work on the Archegoniatæ is doubtless his best-known title to fame. But it is far from being the actual sum of his achievements. It is one of the great merits of von Goebel's book now under review, that it places the life-work of a master of technique and of thought in its true relation, not only to the period in which he lived, but also to the general march of science. It shows Hofmeister as a man of singularly alert mind and clear vision, coupled with a remarkable capacity and enthusiasm for work. There was something almost prophetic in his outlook on science. His perception of alternation was the natural precursor of the discovery of the cytological cycle as we now know it. But more significant still was his pursuit of causal morphology, as developed in his other great work, entitled "Allgemeine Morphologie." This book is unfortunately unpopular in style and almost plethoric in content. But it touched many matters that are still in eager debate: none more so than the inheritance of acquired or impressed characters. On the last page of that work he says: "It appears to me probable that only gradually, in the course of many years' development, the influential effects on outer form appeared and became hereditary." Twenty years later, Sachs advocated the same idea, saying with regard to the perpetual operation of gravity and light: "Many of these effects we are able to-day artificially to call forth or hinder; but others have become entirely hereditary and constant. Evidently one of the most fruitful regions of botanical research lies here before us." It is well to accord full weight to such expressions from great experimental botanists, while considering the later view put forward by Weismann with special relation to animals.

It is impossible in a short review to do justice to von Goebel's thoughtful estimate of his master's life and work. The pupil is, however, also a critic, and he does not hesitate to expose points where Hofmeister's views are out of harmony with later aspects of the science. This feature, associated with the broad outlook of an unusually penetrating mind, makes von Goebel's volume a most valuable addition to philosophical botany.

The remarkable wealth of facts early observed by Hofmeister, and the acute comparisons based on them, revealed the young bookseller as already a leader in his science. Recognition followed quickly. In 1851 he was awarded the honorary doctorate of philosophy of the University of Rostock. A few years later, in 1854, he received a call to the chair of botany in Heidelberg; and in 1863 he was appointed to Tübingen. As professor, he could not be called a popular lecturer. But the list of such pupils as Askenasy, Engelmann, Kienitz Gerloff, Muller, Pfitzer, Timiriassieff, Millardet, Zacharias, and von Goebel shows how powerful and prolific was his advanced teaching. He was, in fact, "a heaven-gifted genius such as in every science appears only at long intervals of time."

This volume presents Hofmeister both as a genius and also as a personality. His character is not only indicated by the pupil who saw him at near hand, in the laboratory and in the field, but also more fully by his daughter, Frau Prof. Ganzenmüller, in a chapter telling of his family life. Several vivid letters to his wife are quoted, and reveal a vivacious and very affectionate nature. But, as said in the translator's introduction to the English version: "The story which the daughter relates of her father's family happiness, and of his phenomenal success in a profession he was never trained for, becomes poignantly tragic as the tale of grievous bereavements quickly following one another reaches its sad climax in solitude of spirit. Her closing paragraphs, as well as his works, claim remembrance for one who, overtaken in 1877 by sickness and death, had persistently devoted almost his last broken powers to the science he had so brilliantly illuminated."

Radioactivity.

A Manual of Radioactivity. By Dr. George Hevesy and Dr. Fritz Paneth. Translated by Dr. Robert W. Lawson. Pp. xix + 252. (London: Oxford University Press, 1926.) 15*s*. net.

IN the hands of the translator and the Oxford University Press, the modest, beautifully printed "Lehrbuch der Radioaktivität" of 1923 has become the imposing, beautifully finished, and handsome English edition of 1926; the little German two-seater is now a handsome blue Daimler saloon complete with coat-of-arms on door.

This book is intended as a manual for senior students and young research workers. In size and scope it is not unlike the earlier books of Fajans and of Russell; and like that of the former, but unlike that of the latter, it pays attention more to the physical than to the chemical side of the subject. This to our mind is a pity, because it was on the chemical side of the subject of radioactivity that the authors made their names, and, whereas the physical side can be expounded by many, a fuller informed discussion by the authors of the chemical problems involved would have been invaluable.

For the most part, the English follows the German edition closely, but whereas the latter takes account of the literature up to the beginning of 1922, the former has been considerably modified and extended, particularly in the sections relating to atomic structure, to embody the results of more recent research. Several of the figures in the German text are now reproduced as plates, which, of course, are much clearer. These include the famous one in which the newly-born nucleus of atomic number 8 and mass 17 is seen bending thickly round to the right while the ejected hydrogen particle makes a bee-line to north-west almost in line with the α-particle which begat it.

The book is not fully documented in the ordinary sense, but many references to the literature during the period 1916–1925 are collected in an appendix, and these suffice for the purpose of the work. The first nine chapters deal with the specially physical side of the subject: the theory of disintegration, the constitution of the atom, and the nature of radioactive particles and rays. This is well but much too briefly put, is up-to-date, and is well illustrated. Too much information is packed away in these chapters which, in length, are not much more than sections, and they are made weightier because any looseness of thought or of statement which the authors have allowed themselves in making clear their subject is sternly corrected in their copious footnotes.

In Chap. x. the transformation series are given. In our opinion the authors are unduly conservative in taking the view that the actinium series arises as a branch from the main uranium series, instead of the more likely view that it derives from a uranium isotope of mass 235 (or 239). In a work of this scope, however, there is little room for a discussion of this point.

Several chapters are devoted to the subject of isotopes, radioactive and non-radioactive, and the possibility of their separation, a subject in which the senior author has done notable work. The three chapters which deal particularly with the chemical side of the work could be enlarged with advantage, since they embody the research work of the authors themselves on such subjects as the chemical behaviour of extremely small concentrations of substances and the use of radio elements as indicators.

A long chapter deals with the various effects of the rays from radium and other radioactive substances, such as their chemical or physiological action or their use in promoting atomic disruption. Few workers are aware how far investigation has penetrated in these regions. Of particular interest at the moment is the work of Lind and his collaborators on the chemical effects of radium rays on liquids and gases. The translator must not, however, call hydrocarbons hydrocarbonates (p. 242), for that may remind chemists of the physicist who in translating a text-book of organic chemistry rendered throughout as *carbohydrate* the German for hydrocarbon. Geologists as well as physicists will find the bearing of radioactivity on geology, and particularly on the age of minerals, ably discussed in Chap. xxvi.

The authors have included a chapter on the historical development of the science of radioactivity. This, we consider, is unnecessary. To the uninitiated the names of all but the greatest of the pioneers convey very little, while those who have borne the burden and heat of the day know that the real history is not that given in any text-book. The translation is very good, and it is quite clear that the translator has contributed considerably to the excellence of the volume. He should, we think, use more extensively the nomenclature of the Chemical Society in rendering chemical terms; for example, *protoactinium* is preferable to *protactinium*, and the name of a chemical element should be written out in the text, the symbol being reserved for chemical equations.

Here then is a book, well-translated, clear, informed, up-to-date, and all too brief, which can be heartily recommended to the student and research worker. May the reviewer, with all respect, give it an affectionate 'pat on the back' in memory of happy days with the senior author in Sir Ernest Rutherford's laboratory in Manchester, in the great days before the War?

A. S. R.

Our Bookshelf.

The Further Studies on Decrementless Conduction. By Prof. Genichi Kato. Pp. vii + 163 + 7 plates + 88 figures. (Hongo, Tokyo: Nankōdō, 1926.) n.p.

IN this second monograph Prof. Kato describes further numerous experiments which he and twenty collaborators at Keio University have carried out on the passage of the impulse in narcotised nerve. An abundance of evidence is adduced to support the now well-known theory that there occurs no gradual decrement of the nerve impulse in its passage through a narcotised region of nerve, but rather diminution to a steady level, as soon as the fully narcotised region is gained. Owing to diffusion at the border of the narcotising chamber, the nerve at that place must needs show a decreasing depth of narcosis at the outer part. This region (the 'limit length') is 6 mm. long and can be accurately defined by mechanical stimulation. Electrical stimulation is attended by the pitfall of 'escape of current,' which, the author maintains, has not been avoided by previous workers. Crushing the nerve is not a proper control of 'escape of current.' 'Escape' or 'spreading' must be differentiated into 'external spreading' along the surface of the nerve (for some 2 mm.) and 'internal spreading' among or within the nerve fibres. This latter, which may amount to some 25 mm., is stopped and therefore not controlled by nerve-crushing. It is estimated in the present series of experiments by determining the apparent diminution of the latent period of the muscle twitch on a smoked record as the stimuli are made stronger and the effective kathode thereby approaches the muscle. This method, though accurate enough, might have been subordinated to one of the elegant and precise electrical methods which are now in vogue for observing nervous phenomena. In most experiments the nerve-muscle preparation of the large Japanese toad has been used. From the few with frog-nerve, there is some evidence that in this tissue the spread of current occurs less readily.

Later chapters describe decrementless conduction in narcotised regions of the vagus and sympathetic trunks and in narcotised muscle - skeletal and cardiac. Experiments have also been made bearing on the relative refractory phase of nerve-fibres. Since the existence of decrement is so much in doubt, the conditions during that phase have had to be investigated from the new point of view. It seems probable that the principle of the all-or-none response is true for the relative refractory phase.

A further communication is promised which, if it is as provocative of thought as the present monograph, will be most welcome to physiologists.

Francis Jenkinson, Fellow of Trinity College, Cambridge, and University Librarian: a Memoir. By H. F. Stewart. Pp. viii + 152 + 6 plates. (Cambridge: At the University Press, 1926.) 10*s.* 6*d.* net.

BIOGRAPHIES of men of renown and national heroes—naval, military, and political—are necessary for the due appraisement by the historian, not merely of the men themselves but also of the times in which they lived. Of greater personal interest are the lives of men of talent, fulfilling faithfully and unostentatiously their daily round, raising their everyday duties to a high level by infusing them with conscientiousness and energy.

Such records are, to most of us, of greater value because they set an example and a standard to which the average can strive to attain. In his memoir of Francis Jenkinson, Fellow of Trinity College, Cambridge, and for more than thirty years University librarian, Mr. H. F. Stewart brings clearly before us the character, as revealed by his daily acts, of one of the most lovable of men. We see Francis Jenkinson as a man of many talents, as a naturalist, a lover of music, and, greatest of all, as a bibliographer and a book-lover. The work he accomplished was little short of marvellous when we know that he rarely felt in perfect health. Though not successful in winning any of the great University prizes, he took as high a place as his limited physical capacity would permit, and was consequently a marked man from the first, and he found his true *métier* as a bibliographer. Succeeding Henry Bradshaw, with whom he had previously been associated and whose methods he whole-heartedly admired, he maintained as librarian the high standard of scholarship exhibited by his predecessor, and carried on in the same spirit the enrichment of the library which was under his care.

The author has related the main events of Jenkinson's official life in a most entertaining book, not overweighted, as many biographies are, with insignificant detail. His subject's efforts, which were largely instrumental in winning the battle of the Copyright Bill and in establishing the unique War Collection, are vividly narrated. Other chapters tell us of his hobbies and recreations — entomology, ornithology, music, gardening—so that we have presented to us an engaging picture of the man as he was and as he will live in the memory of his many friends. The last lines of J. D. Duff's inscription in the ante-chapel of Trinity College admirably sum up his nature:

"Naturam musicam libros
Sed magis homines homo amavit."

His portrait, painted by Sargent in 1915, excellently reproduced here, forms a fitting frontispiece to the memoir, the writing of which has clearly been a πόνος ἄπονος.

H. H. S.

The Migration of Symbols: and their Relations to Beliefs and Customs. By Donald A. Mackenzie. (The History of Civilization Series.) Pp. xvi + 219 + 16 plates. (London: Kegan Paul and Co., Ltd.; New York: Alfred A. Knopf, 1926.) 12*s.* 6*d.* net.

MR. MACKENZIE deals here with four symbols or groups of symbols—the swastika, the spiral, ear symbols and tree symbols—and the religious beliefs associated with them. As a devoted adherent of the 'diffusionist' school, he sees in each the manifestation of an idea or complex of ideas, which, notwithstanding certain local variations in detail, on the whole is universal and derivative from a common origin. The swastika

represents the sun, the four cardinal points, the deities of these points, givers of life associated with the deities, such as gold, and so forth.

While in the case of such a highly specialised form as the swastika there may appear to be a reasonable possibility of a common origin, it might well be argued that a form of such frequent occurrence in both natural and artificial objects as the spiral might have a multiple origin even within a single cultural area. It has been suggested, for example, that in Egypt it is derived from the lotus, while Dr. H. R. Hall derives it from coiled wire used purely for ornament. Mr. Mackenzie does not deny the possibility, although he thinks that the earliest form may have been the spiral derivative from a shell in view of the magico-religious ideas appertaining to shells among the peoples of Upper Palæolithic age in western Europe. He holds, however, that, whatever the material origin, a precedent condition was the fundamental idea of movement, as in whirlpools and the whirlwind, as a giver of life. This opens up an interesting field of speculation in which it is not possible to follow the author here. He has gathered together a large number of examples, which he interprets to support his views in the case of each symbol, and if all are not equally cogent and the argument not in all cases equally convincing, they will at least serve to stimulate discussion.

The Secretion of the Urine. By Dr. Arthur R. Cushny. (Monographs on Physiology.) Second edition. Pp. xii+288. (London: Longmans, Green and Co., Ltd., 1926.) 16*s*. net.

THE appearance of the second edition of this monograph reminds us of the great loss which science has suffered in the untimely death of Prof. A. R. Cushny. It is indeed fortunate that the book was almost ready at the time of his death, since it reflects the considered views of the author on the subject of the function of the kidneys in the light of the most recent researches in this province of physiology. The theory put forward in the first edition nine years ago has formed the starting-point of the majority of the researches carried out on the secretion of the urine during this period: that the work stimulated research is shown by the increase in the number of references from four hundred to six hundred.

The author considers that the modern theory of filtration through the capsule with reabsorption of an optimal fluid in the tubules has been greatly strengthened by the more recent work: in fact, reabsorption has been definitely proved to occur. A slight modification of the theory has been necessary, following the increase in our knowledge: the distinction between threshold and no-threshold bodies, that is, between those substances which do not appear in the urine unless their concentration in the blood exceeds a certain value and those which are excreted, whatever their plasma concentration, appears to be less clean cut than was formerly supposed. Thus, with a modification affecting the nature of the optimal fluid absorbed in the tubules, the author considers that the theory covers all the more recently discovered facts.

We note that the chapters on the perfusion of the kidney and on nephritis have been largely re-written: the latter especially is noteworthy in its broad outlook upon clinical problems and in its suggestion for the best methods of investigating the functions of the kidneys in disease in the light of the modern view of renal secretion.

The Mammals of South Australia. By Dr. Frederic Wood Jones. (Handbooks of the Flora and Fauna of South Australia, issued by the British Science Guild (South Australian Branch), and published by favour of the Honourable the Premier.) Part 3 (conclusion), containing *The Monodelphia.* Pp. 271-458. (Adelaide: R. E. E. Rogers, 1925.)

THE appearance of the third and concluding part of Prof. Wood Jones's work on the mammals of South Australia is a timely reminder that Australia has quite an extensive indigenous fauna of non-marsupial mammals. The overwhelming interest of the marsupials has led to the neglect of the other native mammals, even by the professional zoologist, and adequate material for study is wanting. This state of affairs should be remedied as a result of this memoir. More than one hundred species of monodelphians are known from Australia, over seventy of which are carefully described and figured by the author. His appeal for more work on the Australian non-marsupial mammalia comes with all the stronger force when so useful a guide to them accompanies it, and it is made not a moment too soon, for the inroads into the native fauna by introduced species extends equally to these mammals as to the marsupials. Prof. Jones tells a sad tale of the effects of rabbits, rats, mice, foxes, and cats on the indigenous species. His chapter on the dingo is of special interest. He believes it to be an introduced domestic dog of the true northern wolf type, and the evidence he brings forward on this point is convincing. We are glad to have so authoritative an opinion on the origin of this animal.

The completed work is a most valuable study of Australian mammals, for though only dealing with South Australia, it is virtually a guide to the whole continent. The author and the South Australian Branch of the British Science Guild are to be congratulated on the publication of so valuable, useful, and much-needed a work.

Psycho-Analysis for Normal People. By Geraldine Coster. Pp. 232. (London: Oxford University Press, n.d.) 2*s*. 6*d*. net.

"THIS little book on a big subject" (preface) aims at giving, more particularly for nurses and women teachers, an elementary introduction to the theories of Freud, Adler, and Jung in a form more acceptable than that of "the early exponents of analytic psychology . . . [who] succeeded for the most part in arousing disgust and revulsion" (p. 173). It would seem to be an attempt to neutralise certain ill-effects of 'psychoanalysis' in its rôle of 'rather dangerous plaything of society' (p. 14).

Under the headings instinctive energy, fear, the power instinct, the sex instinct, dreams, sublimation and religion, we are given an account of the libido theory that may possibly be wholly acceptable to some sections of the Jungian school of thought. The bibliography consists of three books on psychology, twelve on the so-called 'new psychology,' and forty-two novels.

R. J. B.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Calculation of the Ages of Radioactive Minerals.

IT is now well known that, granted certain conditions of suitability, the age of a primary radioactive mineral is given to a first approximation in millions of years by the formula $\mathrm{Pb} . C / (\mathrm{U} + k . \mathrm{Th})$, where k is the amount of uranium which is equivalent in lead-producing capacity to 1 gm. of thorium, and $1/C$ is the amount of lead produced by 1 gm. of uranium in a million years. Unfortunately, there has been a serious divergence in the values adopted for these constants by different authors, as a consequence of which the calculated ages are not always directly comparable. It is greatly to be desired that uniformity should be attained in this respect, and we feel that the time is now ripe for the adoption of agreed values of k and C by the various workers in this field of research, at least until unequivocably better data are available.

In a recent paper by one of us (A. Holmes: Estimates of Geological Time with Special Reference to Thorium Minerals and Uranium Haloes, *Phil. Mag.*, May, 1926, p. 1055) the value 6600 was accepted for C. This value was given by Dr. H. Jeffreys in his book, "The Earth," as "the revised value obtained by Lawson and Hess." We have now found, however, that it involves errors both in interpretation of the data and in arithmetic, and that, on the experimental data of Hess and Lawson, the value should have been 7400. On the other hand, H. V. Ellsworth and C. W. Davis in recent papers in the *Amer. Jour. Sci.* have used $C = 7900$, a value suggested by Lawson in 1917; and still more recently in the same journal L. A. Cotton uses $C = 8000$, while O. Hahn in a German publication adopts $C = 8200$.

Probably the most accurate determination of the number of α-particles emitted per second by 1 gm. of radium is that made by Hess and Lawson, using the electrical method of counting. Their value, $3 \cdot 72 \times 10^{10}$, almost exactly corresponds with the measured heat production by radium (NATURE, 116, 897, 1925), and for this and other reasons we believe it to be the most trustworthy at present available. Accepting it, and combining it with the ratio of radium to uranium in uranium minerals, $3 \cdot 40 \times 10^{-7}$, we find $C = 7400$, which we propose as the most trustworthy value on current data.

The values adopted for k have varied between 0·3 and 0·4. Rutherford and Geiger's scintillation experiments on uranium and thorium indicate that per annum 1 gm. uranium gives $1 \cdot 26 \times 10^{-10}$ gm. uranium-lead, and 1 gm. thorium gives $0 \cdot 485 \times 10^{-10}$ gm. thorium-lead. Whence it follows that 1 gm. of thorium produces lead at the same rate as 0·38 gm. of uranium. Judged by later experience, the individual results for uranium and thorium are both probably rather low, but they were reached by the same method in either case, and are thus directly comparable. A slight correction to each of the results makes no appreciable difference to the ratio between them, as in each case it is in the same direction and of the same relative order. We therefore propose $k = 0 \cdot 38$ as the most reliable value at present attainable.

The approximate age of a mineral (omitting the time-average correction) is, therefore, on present data, given most reliably by the formula:

$$\text{Approximate Age} = \frac{\mathrm{Pb}}{\mathrm{U} + 0 \cdot 38\ \mathrm{Th}} \times 7400 \text{ million years.}$$

The application of the time-correction has the effect of reducing the value of the age so obtained. The corrected age can be most conveniently obtained by means of the formula:

$$\text{Corrected Age} = \text{Approximate Age} . \left(1 - \frac{x}{2} + \frac{x^2}{3}\right);$$

where $x = 1 \cdot 155 \cdot \frac{\mathrm{Pb}}{\mathrm{U} + 0 \cdot 38\ \mathrm{Th}}$.

Adopting the factors here advocated, the Middle Pre-Cambrian pegmatites of Ontario, Texas, Colorado, Sweden, and India have an age of about 1000 to 1100 million years.

ARTHUR HOLMES.
The University, Durham.

ROBERT W. LAWSON.
The University, Sheffield.

September 4.

Protoplasmic Viscosity as determined by a Temperature Coefficient of Biological Reactions.

IN a previous note [1] I have shown that the majority of biological processes depend on temperature according to the formula:

$$y = \frac{a}{x^b},$$

when x is temperature in degrees centigrade, y time, a and b constants. I have given some examples which seem to indicate that this equation is very general. I have also mentioned that the constant b, which is a real temperature coefficient (because it does not change with temperature), probably has a wider biological interest.

Let us compare the values of b for one and the same reaction in different species:

Reaction	Species	Author.	b
Amoeboid movement .	Marine amoebae	Pantin [2]	0·90
" " .	Human leucocytes	McCutcheon [3]	2·11
Embryonic development .	*Cyclops fuscus*	Ziegelmayer [5]	1·16
" " .	Drosophila	Loeb and Northrop [4]	2·10
" " .	*Rana virescens*	Lillie and Knowlton [6]	2·36
" "	Chick	cf. Morgan [7]	4·10
Heart-beat . .	Anodonta	Koch [8]	1·10
" .	*Rana temporaria*	Clark [9]	1·06–1·48
"	*Emys europaea*	Galeotti and Piccinini [10]	1·44
" .	*Hynobius lichen.* larva	Inukai [11]	1·15
" .	Duck embryo	"	2·92
"	Dog	Frank [12]	2·06
" . . .	Rabbit	"	3·00
" . .	Cat	Langendorff [13]	2·38

As may be observed from these data, b is generally higher in homoiothermic than in poikilothermic forms. But this is evidently not an exclusive feature of homoiothermy, since b is relatively high also in poikilothermic forms living at high temperatures:

Bělehrádek, NATURE, 118, p. 117, 1926.
Pantin, *Brit. Journ. Exp. Biol.*, 1, 1924.
McCutcheon, *Amer. Journ. Physiol.*, 66, 1923.
J. Loeb and Northrop, *Journ. Biol. Chem.*, 32, 1917.
Ziegelmayer, *Zeits. wiss. Zool.*, 126, 1925.
Lillie and Knowlton, cf. Morgan (7).
Morgan, "Experimental Zoology," New York, 1907.
Koch, *Pflüger's Archiv f. d. ges. Physiol.*, 166, 1917.
Clark, *Journ. of Physiol.*, 54, 1921.
Galeotti and Piccinini, *Archivio di fisiol.*, 8, 1910.
Inukai, *Japanese Journ. of Zool.*, 1, 1925.
Frank, *Zeits. f. Biologie*, 31, 1907.
Langendorff, *Pflüger's Arch. f. d. ges. Physiol.*, 46, 1897.

Reaction.	Species.	Author.	b.
Cleavage of egg .	Strongylocentrotus	J. Loeb [14]	0·99
„ „ .	Ascaris	Fauré-Fremiet [15]	2·50
Growth in plants .	Lupinus (moderate)	Vogt [16]	1·90
„ „ .	*Scirpus Kisoor* (tropical)	Bose [17]	9·50

When we consider further a given reaction in one and the same species, we may observe that *b* increases with the age of the individual :

Reaction.	Species.	Author.	b.
First cleavage of egg	Strongylocentrotus	J. Loeb [14]	0·99
Second „ „	„	„	1·13
Heart-beat . .	*Amblystoma* larvæ, 8, 2·9, 1 mm	Laurens [18]	1·41
„ . .	*Amblystoma* larvæ, 13, 0·25, 1 mm.		1·50
Larval stage . .	Drosophila	Loeb and Northrop [4]	2·10
Pupal stage .			2·28
Imaginal stage . .			1·56 (see later for discussion)

I have calculated the constant *b* also for the rate of development in different stages of the beetle *Dytiscus semisulcatus*, according to observations by Blunck.[19] In this case also the value of *b* increases with age :

Period.	b.
1. Embryonic	1·10
2. First larval instar . .	1·14
3. Second „ . .	1·26
4. Third „ .	1·38
5. Præpupal . . .	1·48
6. Pupal . . .	1·60

These results, when plotted against time, give a regular S-shaped curve (Fig. 1). From Krogh's[20]

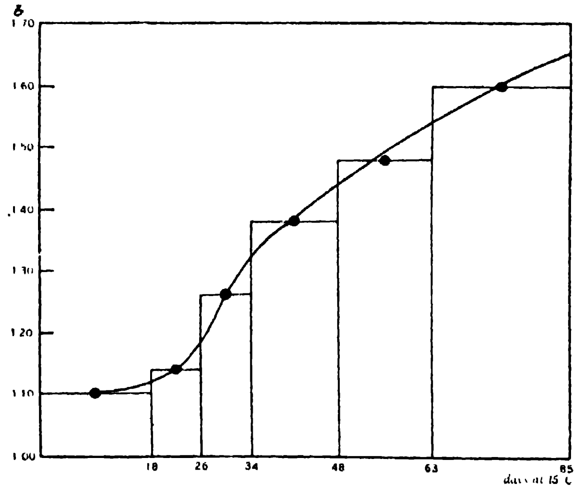

FIG. 1 - The constant *b*, which indicates the degree of protoplasmic viscosity, increases with the age of individual; development of *Dytiscus semisulcatus*.

experimental data concerning the embryonic development of the frog (*Rana fusca*), I have found that *b* increases with time in a similar way, as follows :

Period.	The Beginning and the End of the Period characterised by Stages.	b.
1	Fertilisation—end of the first cleavage .	1·20
2	End of the first cleavage—closure of neural fold	1·64
3	Closure of neural fold—formation of external gills	1·76
4	Formation of external gills—formation of gills with 3 branches. . . .	1·92
5	Gills with 3 branches—embryo 7 mm. long	1·69
6	Embryo 7 mm. long—embryo 7·8 mm. long	2·52

The graph of these values plotted against time probably corresponds to the first part of an S-shaped curve, the most advanced stage in Krogh's experiments being embryos only 7·8 mm. long.

The following example will show that *b* is also increased under the action of narcotics :

Pulsation of vacuole, *Paramaecium caudatum*, normal (Khainsky[21])	1·60
Pulsation of vacuole, *Paramaecium caudatum*, under chloretone (Cole[22]) . . .	1·87

The next example, computed from Hennings'[23] experimental data, demonstrates that *b* increases not only with the age of individual, but also that it is higher in a dry than in a humid atmosphere :

Tomicus typographus.	b in Dry Atmosphere.	b in Humid Atmosphere.
Embryonic stage . . .	2·02	1·87
Larval	3·52	2·98
Free beetle	2·90	2·44
Total development . . .	2·48	2·37

From these data it may be seen that the coefficient *b* varies not only for different biological reactions, but also that it changes even in one and the same reaction under varying external and internal conditions. It would be therefore impossible, at least at present, to identify biological reactions by means of our new formula. But the variations of *b* may be understood without great difficulty if we assume that *b* indicates the degree of protoplasmic consistency (or, physically, viscosity and rigidity). It has been partly demonstrated, partly made highly probable by different investigators, that the viscosity of protoplasm increases with the age of individual as well as under deeper narcosis (see F. Weber[26]). The case of embryonic development in *Tomicus typographus*, cited above, would then indicate that the protoplasm may become more viscous owing to loss of water in dry air.

The S-shaped curve which represents the increase of *b* with age fits well with my previous experiments made on cells of *Elodea densa*, in which the protoplasmic viscosity, plotted against the age of cells, also gives an S-shaped graph.[24] In the development of insects, it may be noted that *b* drops suddenly between the larval period and the imaginal stage (see above, Drosophila and Tomicus). This points to the possibility that protoplasmic viscosity decreases during metamorphosis, which then would involve some sort of rejuvenation. But as the material upon which my calculations are based is not sufficiently large, I do not venture to accept this idea as a definite explanation.

[14] J. Loeb, *ibid.*, 124, 1908.
[15] Fauré-Fremiet, "La cinétique du développement," Paris, 1925.
[16] Vogt, cf. Jost, "Vorlesungen über Pflanzenphysiologie," Jena, 1913.
[17] Bose, *Trans. Bose Research Inst.*, Calcutta, 1, 1918.
[18] Laurens, *Amer. Journ. of Physiol.*, 25, 1914.
[19] Blunck, *Zeits. f. wiss. Zool.*, 121, 1924.
[20] Krogh, *Zeits. f. allg. Physiol.*, 16, 1914.

[21] Khainsky, *Arch. f. Protistenk.*, 21, 1911.
[22] Cole, *Journ. Gen. Physiol.*, 7, 1925.
[23] Hennings, *Biol. Centralbl.*, 27, 1907.
[24] Bělehrádek, *C. R. Soc. de Biol.*, 92, 1925; *Publ. Fac. de Médec.*, Brno, 1925.

The difference in the constant b which exists between poikilothermic and homoiothermic organisms seems to indicate that the protoplasmic viscosity is regulated with regard to the thermal adaptation of a given species.

Any biological reaction is a complex of many physical and chemical processes forming a chain. In determining the temperature coefficient of such a complex, we in effect determine the temperature coefficient of only one of the underlying processes, namely, that which is least accelerated by rising temperature and is therefore the limiting factor of the whole complex (Blackmann's and Putter's principle). In the majority of cases, however, the rate of molecular diffusion in the protoplasm is the limiting factor (see W. M. Bayliss[25]). As the rate of diffusion depends on the viscosity of the reacting system, our hypothesis is justified also from a purely physicochemical point of view.

Thus the protoplasmic viscosity may be studied by simply measuring the effect of temperature on any biological reaction in which the new formula holds good. Further investigations will show whether this way of determining the protoplasmic viscosity would be not only less injurious to the living system, but also more accurate than the existing methods of protoplasmic viscosimetry (see F. Weber[26]).

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August 12.

Science and Psychical Research.

HAVING read with interest the correspondence in recent issues of NATURE arising out of Dr. Tillyard's article on Sir A. Conan Doyle's "History of Spiritualism," I beg space for the following remarks which I shall try to confine so far as possible within the editorial limits stated in the issue of September 11 to be the main point of the reviewer's article of July 31, namely, "that scientific men generally presented an unscientific attitude to the subject of psychical research." But Dr. Tillyard in his article appears to prefer the substitution of the term 'supernormal phenomena' to the term 'subject of psychical research.' Therefore my remarks will deal almost wholly with that department of 'psychical research' which concerns itself with such supernormal phenomena as may be included under the head of *accounts given of communications between living persons and the* 'discarnate' spirits, or 'intelligencies,' or 'ghosts' of those who are normally called the dead, and thus omit here all reference to much of the material studied by the Psychical Research Society, for example, telepathy, etc., as quite irrelevant to this correspondence.

All the statements regarding the above-named accounts hitherto published and believed to be true by some of all descriptions of persons, including such as are or have been students of various branches of science, lack any evidence of a character which could make possible their submission to strict scientific investigation, the requirements of which I need not repeat in these pages. In this statement I include all the accounts given or referred to by Sir A. C. Doyle or his reviewer in the "History of Spiritualism." Recently when talking with Sir Ray Lankester about a review he had written of Sir A. C. Doyle's book, and the ghost-stories it contained, he brought to my notice the following quotation from some remarks made by Mr. T. P. O'Connor in the *Sunday Times* of August 15 in connexion with a conversation with Sir Edward Clarke, the chief counsel for the plaintiff in the case of O'Shea *v.* Parnell. In the course of this case it was proved that there was no 'fire-escape' in the house in question. "This," says Mr. O'Connor, "was not the first time I realized the truth of the statement that you cannot be quite sure that you know all the facts of any historical or personal transaction. I never trust implicitly any historical statement. I have rarely seen any of the historical transactions in which I myself have taken a part strictly recorded according to the facts." Sir Ray thoroughly endorsed Mr. O'Connor's attitude as to placing no reliance on such 'story-telling,' and holds that it applies equally to reputed researches by eminent scientists—all hearsay—and useless as evidence.

On all of the many occasions, within a period of more than fifty years, when I have given serious attention to allegations of facts made by students of the 'occult' or so-called 'supernormal phenomena,' I have found that the actual necessities for carrying out scientific investigation were unattainable, the consent of the 'medium,' whether 'professional' or not, being withheld.

Scientific men generally do not refuse to examine into any matters of reputed or seeming importance on the ground of certain alleged facts being impossible, or even highly improbable. They cannot, however, but refuse to make inquiry into any matter when the conditions of investigation, necessarily required, are denied or restricted and actual experiment thus excluded. As one example only of an unproved statement made in the course of the present correspondence, I quote that of Dr. Tillyard's in which he says that in a certain class of cases "the medium is actually in trance and does not know what is going on." I do not know what he means by the word 'trance,' but his statement would seem to be of some importance to spiritualists and the Psychical Research Society, as in the present dispensation of their doctrines the 'entranced' medium plays a most important part in the manifestations of occult phenomena generally. I am not aware, after making several inquiries into this point, of any thorough investigation having been made into the condition of a 'medium' reported to be 'entranced.'

BRYAN DONKIN.

September 17.

THE present controversy, which the editor of NATURE has wisely confined to a discussion of the "*scientific* study of what are called *supernormal phenomena*," is somewhat confused by the irrelevancies which have been introduced into the debate.

The entomologist, Dr. Tillyard, complains that his critics confuse psychical research with spiritualism, when the fact is that his original article was a review of a book on spiritualism and not on psychical research. Moreover, when he accuses Dr. Lotsy of making "the usual blunder of those who, knowing nothing of the elementary principles of psychical research, persist in regarding the medium as the 'guide' in the experiments," he himself is betraying his lack of acquaintance with the subject. This is readily excusable since, I believe, his experience with physical mediums is limited to less than a dozen sittings. Apart from this, Dr. Tillyard's statement strikes at the root of the present discussion. The majority of scientific men suspect that what Dr. Tillyard denies is true, namely, that the medium is the 'guide' in the experiments. In this they are right, although the words 'and his/her manager' might be added to the word 'medium.'

The conditions of experiment are usually arranged

[25] Bayliss, "Principles of General Physiology," London, 1918, p. 41 *seq.*
[26] F. Weber, *Abderhalden's Handb. d. biol. Arbeitsmeth.*, vol. 11, 2, 1. half, 1924.

by the medium or by the manager in conformity with a set of arbitrary rules laid down by generations of spiritualists for reasons into which we need not enter here. The séances are of the nature of performances at which the 'investigator' takes his place in a 'chain' of believers, who see that he does not violate the rules, which are framed in such a way that any real investigation is impeded. Can Dr. Tillyard tell us of any single medium who can produce some simple raps, under conditions which render their normal production impossible? He will doubtless reply by stating that 'supernormal' phenomena are subject to certain conditions and it is only under certain conditions that they occur. This appears reasonable, but Dr. Tillyard's experience is too slight for him to be able to recognise that the conditions are not "just exactly what the researchers choose to make them" (NATURE, September 11, 1926, p. 370), but what the medium plus his manager or employer have chosen to make them.

In this respect the cordial invitations which are so often extended to prominent persons are highly suggestive. It is now becoming a common thing when a new medium appears for his or her manager to invite scientific men in other spheres of work, journalists, actors, etc., to be present at the 'experiments.' Great care is taken to prevent the systematic attendance of critical psychical researchers and others with much experience of mediums, for these are not likely to be impressed by the trappings of a pseudo-investigation, and are also acquainted with those sources of error which, from their very nature, must remain unknown to the ordinary scientific worker, who has not specialised in this line of inquiry.

There is a good case for the scientific study of what are called supernormal phenomena. The difficulty lies in obtaining the opportunities for any such investigation under conditions satisfactory to those whose experience leads them to adopt a critical attitude towards the problems in dispute.

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The Egyptian Shadouf and the Rate of Human Work.

THE interesting paper by Drs. Haldane and Henderson in NATURE for August 28, p. 308, merits emphasis on two or three points. Above all, the mechanical beauty of the shadouf, in spite of its crude construction, deserves notice It will be observed that trunnion bearings, which would wear and need lubrication, are replaced by almost frictionless hinges in the form of ropes. These ropes, in addition to their antifriction qualities as hinges, confer an important property on the system, namely, elasticity.

In short, the shadouf is a pendulum, and almost without doubt the men who work it move with it in its natural free period. If this is so, it would constitute a remarkable anticipation of recent developments in Germany, where many reciprocating machines have been constructed on resonance principles with marked gain in efficiency.

About the middle of last century, when most cranes and winches were operated by hand, it was necessary, for purposes of design, to have some standard of human activity. A widely accepted figure for such work was one-tenth of a horse-power or 3300 foot-pounds per minute. D. K. Clerk, a respected authority of that period, gave this rate as "the average net daily work of an ordinary labourer at a pump, a winch or a crane, for eight hours a day." "For shorter periods, from four to five times this rate may be exerted." Taking the rate given by Clerk for eight hours, we have 1,584,000 foot-pounds per day, in close agreement with the shadouf worker's 1,550,000 foot-pounds.

As to exteme rates of activity for short periods, comparisons are most difficult. Probably the highest rates are exhibited by professional wrestlers and strong men, whose feats are sometimes performed at a rate of the order of four horse-powers.

H. S. ROWELL,
Director of Research,
Research Association of British Motor
and Allied Manufacturers.

Chiswick, W.4,
August 30.

THE figures of 4290 foot-pounds per min. for raising water, and 4230 foot-pounds per min. for raising earth, given by Dr. Haldane and Prof. Yandell Henderson in NATURE of August 28, as examples of the rate at which work can be kept up for lengthy periods, are confirmed by the common experience of hill climbers. A man of average weight, dressed in climbing kit, and carrying a load of, say, 15 or 20 lb., may be assumed to weigh about 180 lb. To walk uphill at the rate of 1250 feet per hour, at low or moderate altitudes, is quite ordinary; while 1500 feet per hour is generally considered as distinctly fast. Such figures would apply to persons in good training, and to ascents lasting for, say, 4 hours. The rate to correspond with 4200 foot-pounds per min. would be 1400 feet per hour.

It would be interesting to measure the rate of oxygen consumption of persons walking uphill for lengthy periods; for given rates of ascent and for various gradients; and to compare the results with figures obtained from the same individuals working an ergometer in a laboratory. The question of gradient cannot be entirely ignored. Clinometer measurements of Alpine paths indicate that the economic gradient is about 18°, or 1 in 3. It certainly lies between 16°, which is unnecessarily flat, and 20°, which is uncomfortably steep.

P. J. H. UNNA.

4 Dean's Yard,
London, S.W.1,
August 31.

Antagonistic Action of Electrolytes and Permeability of Membranes.

THE problem of the antagonistic action of electrolytes in biological systems has attracted attention for a long time, but a similar effect on inorganic colloidal systems has been investigated only in recent years. This study has, however, thrown considerable light on the mechanism of such antagonistic action, and we are now probably able to give a rational explanation on the basis of these physico-chemical investigations. About a decade ago Clowes (*Jour. Phys. Chem.*, **20**, 407, 1916) showed that a marked analogy exists between the transformation of an emulsion of oil-in-water into an emulsion of water-in-oil, or of blood plasma into a blood clot, or of a casein suspension into a casein clot. In all these cases salts of calcium promote and alkalis and salts of sodium inhibit the transformation of a system consisting of a non-aqueous phase dispersed in water into the reverse type of system, consisting of water more or less perfectly dispersed in a non-aqueous phase, and the ratio in which given electrolytes, say

sodium or calcium chloride, exert a compensatory effect upon one another, is almost the same as that in which the electrolytes in question exert antagonistic or compensatory effects on one another in biological systems.

In some recent papers (*Zeit. anorg. Chem.*, **142**, 345; **149**, 139, 1925; *Jour. Phys. Chem.*, **29**, 517, 1925) I have examined the behaviour of several colloidal solutions from this point of view, and have shown that a general explanation for all these cases of ionic antagonism is that the similarly charged ion goes to stabilise the suspension, which effect is antagonised by the presence of a coagulating ion. The equilibrium in biological systems, the inversion of emulsions, and the coagulation of colloids in the presence of mixtures of salts can all be explained from this simple view, which is also supported by experimental facts.

The effect of such non-electrolytes as the organic anæsthetics in antagonistic experiments is similar to the salts of calcium, as has been shown by Lillie and others. In these cases we are dealing with the coagulating effect of the non-electrolytes on the dispersoid system. Thus it is now known that copper ferrocyanide membranes, which also show under suitable conditions a reversible variation in permeability like protoplasmic membranes, can be coagulated by means of propyl and other alcohols, but in the presence of membrane-forming materials the coagulation of the membrane is retarded. This is to be attributed to an antagonism between the non-electrolyte and the electrolyte in question. Consequently a general statement of the observed antagonism in diphasic systems is that *all antagonistic actions occur between a peptising agent and a coagulating agent.* This antagonism need not be confined to two electrolytes only, but may occur between an electrolyte and a non-electrolyte. If the concentration of one of these is constant, then at a particular concentration of the other the whole system will be in equilibrium. In freely reversible systems the equilibrium ratio of these will be approximately constant, but this cannot be expected in systems which are irreversible. In the case of ionic antagonism, it has been found that the adsorption of similarly charged ions stabilises the suspension towards another coagulating ion and naturally, therefore, the nature of the electric charge on the surface of the dispersoid or emulsoid particles in the case of physiological systems must be of fundamental importance in showing a variable permeability under different conditions. K. C. SEN.

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India.

Lightning.

DR. SIMPSON'S rejoinder accompanying my recent letter (NATURE, August 7) indicates that I have signally failed to convey to him the ideas which I endeavoured to present. For this I am sorry. A more detailed discussion, being inappropriate for these columns, will be presented elsewhere, but two items of his rejoinder should be mentioned here and now. Dr. Simpson quotes and by implication interprets an isolated sentence. I fail to see how this implied interpretation can be considered to be compatible with the remainder of the paragraph from which the sentence was taken. Second, he is quite mistaken in thinking that the electronic darts which I pictured are but little different from the negative discharges which he considered. His discussion of the latter contains no suggestion of such darts. N. ERNEST DORSEY.

August 17.

DR. DORSEY complains that my interpretation of the sentence which I quoted from his letter is incompatible with the remainder of the paragraph from which it was taken. If this is so it is not my fault, for the paragraph in question contains the two following incompatible sentences: "the branches are not outgrowths from the trunks but ingrowths to it" (which is the sentence I quoted), and "a branch may grow in length and may branch."

I can assure Dr. Dorsey that I did my best to understand his difficult letter and to explain the points in which his theory appears to differ from mine. I cannot, of course, expect him to agree with me, but I regret that he considers that he has cause for complaint. G. C. SIMPSON.

August 31.

The Absorption Spectrum of Formic Acid Vapour in Relation to Molecular Associations.

THE absorption spectrum of formic acid vapour at room temperature and above (to 145° C.) consists of about thirty-five bands, lying between $\lambda = 2565$ and 2250 Å.U.; at the ultra-violet end of this band spectrum there appears to be a continuous absorption.

The law of distribution of practically all the bands may be represented with close approximation by the formula:

$$\frac{1}{\lambda} = 41700 + n \,.\, 1050 + p \,.\, 385,$$

where $n = -2, -1, 0, +1, +2$ and $p = -7$ to $+7$.

The null-band ($n = 0$, $p = 0$) is the strongest band and corresponds to

$$\lambda = 2398{\cdot}0 \text{ Å.U.}, \quad \frac{1}{\lambda} = 41700 \text{ cm.}^{-1}$$

There are two fundamental periods of atomic vibrations in the molecule, $\alpha = 1050$ and $\beta = 385$ cm.$^{-1}$. It is important to mention that the larger fundamental period is of the same order of magnitude (about 1000 cm.$^{-1}$) as is obtained for a number of molecules with a C-O group: formaldehyde (V. Henri and Shoù, $\alpha = 965$ cm.$^{-1}$), diacetyle (V. Henri and L. Light, 1100 cm.$^{-1}$), paraquinone (V. Henri and L. Light, 1110 cm.$^{-1}$), benzaldehyde (V. Henri and Almasy, 945 cm.$^{-1}$), furfurol (V. Henri and Almasy, 1080 cm.$^{-1}$), acroleine (V. Henri, 1260 cm.$^{-1}$), phosgene (V. Henri and Howell, 902 cm.$^{-1}$). In the infra-red there is a strong carbon monoxide band at $\lambda = 9{\cdot}2\mu$, $1/\lambda = 1087$ cm.$^{-1}$. It is therefore quite probable that this period 1050 cm.$^{-1}$ of formic acid vapour corresponds to the vibration of the oxygen relative to the carbon atom.

With increasing temperatures (using a constant mass of 60 mgm. in the absorption tube, between the room temperature and 145° C.) the absorption limit approaches the visible, and more bands of the same kind appeared towards the visible end of the spectrum.

The simplicity with which the above formula represents all the bands leads to the belief that these bands are due to the absorption of one kind of molecular species. The fact that at elevated temperatures the number of single molecules (HCOOH) is much increased, while the number of double molecules $(HCOOH)_2$ is decreased, leads to the conclusion that the banded absorption spectrum is due to the single molecules. (At 145° C. the ratio of single molecules to double is about 7 : 1, and at the room temperature it is about 0·3 : 1.)

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The Scope of Organic Chemistry.[1]

By Prof. J. F. THORPE, C.B.E., F.R.S.

THE chemistry of the compounds of carbon covers a wide field, wider than that covered by any other element. Its scope embraces all living matter, as well as the vast number of non-living substances which are produced through the agency of life. Moreover, it includes a very great number of compounds unrelated to life or to living processes which have been built up by the chemist in the laboratory by methods he has devised.

Already some 200,000 definite compounds have been tabulated in Richter's Lexicon and in the supplements thereto, and this number is increased yearly by several thousands through the agency of a band of zealous workers scattered over the globe. It may well be asked what is the good of continuing to increase this already astonishing number; and is the expenditure of time, labour, and energy justified which lead to the discovery of some new fact having, apparently, no useful application to any department of human activity?

The answers to these questions are quite clear and definite. We must acquire a knowledge of the simple before we can attack the complex with any hope of success. The element carbon has been used by Nature as the basis of organised life because the capacity of carbon to combine with itself is shared by no other element, and it is upon this capacity that Nature has relied in order to build up the tissues and reserve materials which form the living world around us. Moreover, since the compounds of carbon containing a moderate number of atoms of the element are usually crystalline or capable of becoming crystalline, and there are obvious disadvantages attaching to the use of potentially crystalline substances as the basis of living matter, it has been found necessary to employ the more complex carbon derivatives containing many hundreds of elemental atoms, which by reason of their high molecular complexities no longer possess, or seem capable of acquiring, a crystalline structure, but belong to the class of jelly-like or colloidal substances.

Until we can determine how a small number of carbon atoms combine one with the other, we cannot hope to obtain any insight into the manner in which the more complex natural substances are built up, or any information regarding the way in which they are utilised to bring about the changes occurring during animal and vegetable metabolism.

STRUCTURE.

The science of structural organic chemistry is only just fifty years old. It was born when the genius of van 't Hof gave to the world the clue upon which the three-dimensional formula we now use is based. It is therefore no inconsiderable achievement to have gained in so short a time a knowledge of many of the reactions and properties of the more simple complexes of carbon in combination with oxygen, nitrogen, and other elements. But much yet remains to be done before we can attack with any real hope of success the problems which the chemistry of Nature presents.

It is true that the knowledge already gained has led to the synthetic preparation of quite a number of natural products, many of which are of service in relation to human needs. Many of the alkaloids, colouring matters like indigo and alizarine, camphor, and a large number of natural products, have yielded the secrets of their structures and have been produced by laboratory methods and, where necessary, on the factory scale. But the synthesis of such compounds has not provided much insight into the mechanism leading to their production in Nature, and indeed the reason for their occurrence in the plant is not understood. They are, moreover, crystalline substances which either occur in the plant as such or are formed by the hydrolytic fission of some more complex plant materials. Their homogeneity is therefore not open to doubt, and their degradation into known fragments and the rebuilding of these fragments into the original substances, although by no means easy, is nevertheless comparatively simple when the difficulties attending the investigation of more complex natural products are taken into account. Even so, some of the simpler type, for example, strychnine, still resist the attack of the chemist.

BIOCHEMISTRY.

In its earliest days the science of organic chemistry dealt only with those compounds which were derived from natural sources, and it was regarded as certain that such substances could be produced only through the agency of life and by no other means. Since then this theory has been shown to be wrong by the preparation in the laboratory of many substances identical with those formed during the operation of life processes. Nevertheless, the more complex substances which Nature utilises in building up her animal and vegetable structures still show no signs of yielding the secrets of their constitutions, or the mechanism by which they are produced. Indeed, although we can imitate in the laboratory certain natural operations such as the hydrolysis of starch to glucose, we are still quite ignorant of the means by which glucose is converted, by the appropriate enzyme, into alcohol and carbon dioxide, neither can we imitate this process in the laboratory.

When once the chemist has passed beyond the crystalline and the distillable he enters a region full of difficulties, because he has few means either of purifying the materials with which he has to deal, or of determining their homogeneity when they have been purified. These are the real difficulties which confront the biochemist when he approaches his subject from the structural side of organic chemistry.

It is far from my object to disparage the wonderful work which has been done and is being done by physiologists and pathologists in their attack on the mechanism of normal and abnormal life processes. Their record speaks for itself. But too little is being done to approach the problems from the purely organic chemical side, and too few of the people engaged in biochemical research have an adequate knowledge of organic chemistry or the methods of the organic

[1] From the presidential address to Section B (Chemistry) of the British Association, delivered at Oxford on August 5.

chemist. The number of organic chemists who are co-operating with biologists in their attack on natural processes is too few. Indeed, the very difficult question arises here as to how best to organise methods for dealing with problems which are essential borderland problems between two great sciences.

It seems that the best method to attack problems in borderland subjects is by co-operation between two types of trained investigators. In the case of biochemistry, for example, by the provision of trained students of two kinds, one trained in physiology but with a sufficient knowledge of organic chemistry to promote sympathy with and knowledge of the chemist's point of view, and the other trained as an organic chemist with a similar knowledge of the methods and requirements of the physiologist. The former would be a trained physiologist who would devote his final year to organic chemistry, the latter an organic chemist who would devote his final year to a study of physiology. This is, of course, no new idea, but is one which is being carried out in at least one institution in Great Britain in connexion with other borderland subjects.

It is the absence of any real attempt to approach biochemical problems from the chemical side that renders it particularly desirable that the need for some such scheme should be emphasised. It is true that the fault is largely on the side of the organic chemists who, for the most part, seem appalled by the difficulties attaching to the study of natural processes. The difficulties are indeed great, but not insurmountable. We are far from gaining any insight into the meaning of life, but it is not unlikely that we shall, in the near future, obtain some information regarding the mechanism of the action of the enzyme, the important agent in the non-living transformation of living matter into chemical products. It may be that organic chemists are waiting to see how Willstätter, who has already made great progress in enzyme chemistry, will surmount the difficulties confronting him, and it may well be that this great organic chemist will introduce new methods of attack which will open up fresh fields for investigation.

PETROLEUM.

The complex hydrocarbons which form the main constituents of crude petroleum belong to a section of organic chemistry at present too little explored. Although many millions have been made through the production and sale of petroleum products it is safe to say that the percentage of profit devoted to research in oil products has been infinitesimal. It is true that in the United States large sums are given by the oil interests towards research in other subjects, but until quite recently none of these was, curiously enough, given for the purpose of improving our knowledge of the science on which the utilisation and isolation of petroleum products depends. The reason is not far to seek. The apparently inexhaustible supplies of petroleum render it unnecessary to devise means for economical working. The crudest and most wasteful methods were employed, because economy and the conservation of the natural product were not paying propositions.

This applies not only to the methods used in fractionisation, but also to those employed for the purpose of 'cracking' the higher boiling fractions into liquids of lower boiling point. For at the present moment it is the fraction up to 200° C. which is the important product, because it is the 'petrol' of the internal combustion engine. Time was, before the introduction of this particular machine, when the light fraction from crude petroleum was a drug on the market, and in many cases was actually set on fire at the refinery because no use could be found for it. In those days the chief product was the kerosene fraction which was used as lamp oil. At the present time the rapid increase in the use of the motor-car for personal and commercial transport indicates that at no distant period, if progress continues to be made in the same direction, the amount of the 'petrol' fraction will be insufficient for the world's needs. This point has already been reached in America, where approximately 70 per cent. of the world's consumption of petrol (gasoline) is effected. During 1925 the consumption of petrol in the U.S.A. approached 800,000,000 gallons a month, which is about twelve times the amount consumed in Great Britain.

The 'cracking' operation is now carried out on an enormous scale by numerous processes, all subject to patents, but differing from one another only slightly on the question of principle. All depend on the well-established fact that hydrocarbons of high molecular weight will break down into those of lower molecular weight if they are subjected to the requisite degree of temperature. Pressure appears to play an important part in the character of the product, as does also the surface action of the container or material used in the container to promote surface action. All are wasteful, because little or no research has been carried out on the true chemical nature of the cracking operation. Much permanent gas is always produced, consisting for the most part of ethylene and propylene. In the States the ethylene is allowed to go free, because its obvious utilisation in the form of ethyl alcohol is attended with difficulties, but the propylene is usually absorbed in sulphuric acid, and thus converted into *iso*propyl alcohol, useful as a solvent.

The production of these two unsaturated hydrocarbons provides a clue to the mechanism of the cracking process which is of some significance. If you break a long-chain saturated hydrocarbon, one of your products must be an unsaturated hydrocarbon, and it is evident that cracked spirit contains a considerable proportion of such unsaturated bodies. Moreover, the cracking processes at present in use do not produce aromatic hydrocarbons, and it is on the presence of a proportion of these aromatic hydrocarbons that certain special properties of petrol depend. For example, the tendency at the present time is to produce for motor-cars internal combustion engines of increased compression ratio, in order mainly to diminish the petrol consumption and thus increase mileage per gallon consumed. For some reason, which research has not yet ascertained, the use of petrol which does not contain the right quantity of aromatic hydrocarbons of the benzene type leads to 'detonation,' 'knocking,' or 'pinking' when ignited in cylinders giving more than a small compression ratio. This detriment diminishes the value of cracked spirit as such for any but low-compression engines, and many have been

the devices suggested in order to overcome this difficulty.

A vast number of substances, selected more or less at random, have been tried as 'anti-knock' materials, and as an outcome it has been found that one, namely, lead tetraethyl, possesses the property, when present in exceedingly small quantities, of preventing the 'detonation' of the explosion mixture in the cylinder. For a time lead tetraethyl (ethyl gas) fell under a ban in the States owing to a fatal accident which attended the spilling of a certain amount in one of the American factories, but it is understood that further investigation has led to a revision of the view first formed, and that considerable quantities of 'ethyl gas' are now being used. I remember visiting Wilmington in 1924, when some 500 gallons of lead tetraethyl were being made daily. Although there was naturally a strong smell of the material in the factory building, and I remained for some hours there, no ill-effects were noticed.

It is obvious that the conditions which produce 'knocking,' and the reason why certain substances are 'anti-knock' compounds, and why the presence of aromatic hydrocarbons prevents the phenomenon, must be made the subject of systematic research.

The question is also one of national importance, because in the case of high-compression engines, such as those used in aeroplanes, it is essential that a petrol should be used containing a high percentage of aromatic hydrocarbons. In war-time these aromatic compounds will be required for the manufacture of explosives, and it is quite certain that there will not be enough for both purposes.

Nevertheless, it must be remembered that it is only at the moment that the low boiling fraction of petroleum is the chief marketable product. It is probable that progress in the future will tend more and more to produce a motor-car engine of the Diesel type, or one having a carburettor capable of effectively vapourising the higher fractions of petroleum. In these circumstances it may well be that the low fraction will become the less important part of crude petroleum, and that, instead of having to resort to 'cracking,' a process of synthesis, by which the lower hydrocarbons can be converted into higher ones, will have to be adopted. As a matter of fact there are methods known by which this can be effected. Pure *iso*amylene can, for example, be converted into diamylene by interaction with stannic or aluminium chloride, and the process can be carried further, so that perfectly good lubricating oils can now be made by the polymerisation of the lower unsaturated hydrocarbons.

Polymerisation and depolymerisation are therefore the two operations which the petroleum industry must, investigate and establish on a firm scientific basis by research, so that it may be in a position to supply the public need for any particular form of engine which the engineer may evolve. Especially is it desirable to ascertain under what conditions polymerisation leads to the formation of aromatic and naphthenic hydrocarbons. Considerable attention has been directed within recent times to what may be termed in general the Bergius processes for depolymerising organic substances. The operation, which consists in heating the material under high pressure in the presence of hydrogen, was introduced in the first instance for the treatment of coal. There can be no question that great and fundamental changes are brought about in organic substances by the treatment whether a catalyst is present or not, and that a wide field for research is opened up thereby, but it is doubtful if, at the moment, general operations of this type can be regarded as commercial propositions. The plant is exceeding costly and the conditions subject to wide variations which are difficult to control. Actually, it has been ascertained that in the 'cracking' of the kerosene fraction of petroleum, hydrogen is unnecessary and can be replaced by nitrogen without affecting the character of the final product.

Little is known of the constituents of crude petroleum, or indeed of the fractions into which it can be separated after purification and distillation. Some of the simpler hydrocarbons of the pentane and hexane type have been isolated and the presence of cyclic compounds has been established. Many of them are classed under the head of 'naphthenes,' but these are of uncertain structure. No doubt many are present in the crude oil, but it is certain that others are formed during the distillation process. It is clear that much opportunity for research work offers itself here, and it is probable that small alterations in the method of distillation may cause deep-seated changes in the character of the distillate, causing it to be of greater service for particular purposes. The occurrence of hydrocarbons of the naphthalene series in petroleum products has also been clearly established. The higher fractions which constitute the valuable lubricating oils also need attention, for it is now certain that viscosity bears no relation to oiliness, that is, the capacity for acting as an efficient lubricator. The addition of small quantities of 'polar' substances of the type of fatty oils or acids confers increased oiliness on these compounds, and although we are now gradually reaching a stage when we know more about the effects of such ingredients, the field for research is still a large and important one.

The formation of free carbon occurs during both the distillation and 'cracking' process, in some cases to a very considerable extent. The utilisation of this carbon for the purposes of making electrodes is an important part of the industry, and the formation of carbon in a condition in which it can be used by the rubber tyre manufacturers is also likely to become practicable as an outcome of the thermal decomposition of hydrocarbons.

At present we know nothing about the structure of the hydrocarbons present in the lubricating oils. Indeed, it seems possible that these may not be long-chain hydrocarbons with which the organic chemist is familiar, but rather polymerised products formed from unsaturated components liable to be formed or destroyed under comparatively mild conditions. The relative ease with which the oil in the engine sump of a motor-car loses its oiliness through continued use is not characteristic of the stability usually associated with an organic hydrocarbon.

It is clear, therefore, that the need for systematic research into the character of petroleum products is urgent, and it is gratifying to note that the Anglo-Persian Oil Company has established a research laboratory at Sunbury-on-Thames, in which the

important principles underlying the industry have been and will be studied.

DYESTUFFS AND INTERMEDIATES.

Prior to the War, Germany manufactured three-fourths of the dyestuffs required for the world's markets. Of the remaining one-fourth, one-half was made from German intermediates and was therefore dependent on Germany. Switzerland, although without a domestic source of raw materials, ranked second with about 7 per cent. of the world's production. Great Britain produced about one-tenth of her requirements, and France produced in French-owned and operated plants from 10 to 15 per cent. of her consumption. In order to meet the patent requirements of France and Great Britain, German manufacturers operated plants in those countries where the final assembling operations were completed. The small dye industry of the United States was almost entirely dependent upon German intermediates. At the present time Great Britain produces 80 per cent. of the dyestuffs required for its own use, and we are therefore in a position to review the conditions which have led to this remarkable change and to consider the procedure necessary to strengthen it.

It cannot be said that any fundamental advance in the chemistry of the dyestuffs has been made since Bohn discovered indanthrene in 1901, although great advances have been made since then in the preparation of new colours belonging to this and other known series. Consequently, the research work necessary in order to establish our position as a dye-making country has been mainly along known lines, involving the extension of reactions which had already been established rather than the discovery of new ones. Nevertheless, it is no inconsiderable achievement for our research chemists to have established a position such as that indicated above in so short a space of time, for many of the preparations, the details of which could only be found in the patent literature, had to be worked out *de novo* and the correct conditions found for their adaptation to the technical scale.

It is probably along the lines of decreased cost of production that research work in the immediate future will be mostly engaged, and especially is this the case with the intermediate products from which the dyestuffs are derived. Moreover, the intermediate products are of the greatest importance for other industries, for example, the fine chemical industry, the perfumery, and the explosives industries, and any improvement in the processes for their manufacture or the production of new compounds having enhanced value from the commercial point of view is of the greatest importance to all these industries alike. The parent substances of the intermediate products are the hydrocarbons of coal-tar or the coke-oven by-products. The operations required to convert these hydrocarbons into the finished intermediates often involve many stages, any one of which depends for its cost on the purity and yield of the product. There is thus a wide field for research into the improvement of technical methods which may well occupy the attention of our dyestuffs chemists for some time to come.

On the other hand, the question of fundamental research into new processes, both for the preparation of new intermediates and new dyestuffs, must not be lost sight of. The intermediate determines the character of the dyestuff, and it is always possible that a new intermediate may be discovered which will yield a dyestuff with just that difference of shade as to catch the public fancy, and will lead to the replacement of the older dyestuff on the market. The sulphonic acids of naphthol, naphthylamines, and amino-naphthols are cases in point. These substances are used extensively for the preparation of azo dyes. There is a great number of these compounds theoretically possible, but only a few have found technical application, owing mainly to the high cost of producing the others. The high cost is nearly always caused by poverty of yield, an objection which may be at any time removed by the discovery of an improved process. The same argument holds good for the dyestuffs themselves.

It is futile to say that the vast field of organic chemistry has been thoroughly explored for the production of new types. At any moment one or other of the men or women engaged in fundamental research may repeat Bohn's discovery of 1901, and obtain a new compound which will be the forerunner of a new series of dyestuffs. It is perhaps too much to ask an industry which is struggling to hold its own to expend large sums on the prosecution of abstract research, most of which will be of no use to it, but it is not too much to expect that the industry will take every means to foster and encourage abstract research in our university institutions, and even to give some lead as to the direction in which its experience leads it to think that advances may be made. There is at present no organisation which can bring the manufacturers of dyestuffs and intermediates into touch with the work being carried on in our university laboratories, and it is possible that if at the present time a valuable discovery were to be made it would be unrecognised as such, and, following the usual course of academic research, would be published and thus lost to the country. What is required is a lead from manufacturers which will indicate the matters which they regard of importance, but which they do not consider as likely to yield results sufficiently quickly to justify them in employing their own research staff for investigating them.

This aspect is of all the more importance at the present time, when organic chemistry is entering on a new phase which will undoubtedly revolutionise many of the existing processes of manufacture. It is now recognised that the presence of a small quantity of a catalyst may either alter the course of a reaction or may lead it to proceed to completion where otherwise a totally inadequate yield would be obtained. The catalyst may either be added or the containing walls of the reaction vessel may act in this capacity. The well-known example of the oxidation of naphthalene to phthalic anhydride by vanadium pentoxide is an example of this, but similar cases are continually recurring, and it has only recently been found that the classical method for preparing ketones by the distillation of the calcium salt of the appropriate acid can be utilised in the most unexpected directions if the thorium salt instead of the calcium salt is employed.

Francis Bacon and Scientific Method.

By Dr. C. D. BROAD.

I.

FRANCIS BACON, who died on April 9, 1626, and whose tercentenary is to be celebrated at Cambridge on October 5 of the present year, was born at York Place, Strand, on January 22, 1560/61. His father was Nicholas Bacon, Lord Keeper to Queen Elizabeth, and his mother was Anne Cook, daughter of Sir Antony Cook, who had been tutor to Edward VI. Bacon went to Trinity College, Cambridge, at a very early age; he was only fifteen when he finally went down in 1575. He was sent to France by his father, who died while he was there, leaving Bacon ill provided for. He decided to follow the career of a lawyer, and was admitted to Gray's Inn on November 21, 1576. During Elizabeth's reign Bacon had much legal work to do, and received many promises of preferment, but he was not greatly rewarded either in money or in offices. Under James I. his advancement was rapid. He rose to be Lord Chancellor and Baron Verulam in 1618 and Viscount St. Albans in 1620–21.

This was the culmination of Bacon's career. On May 3, 1621, he pleaded guilty to a charge of corruption; was fined 40,000*l.*; imprisoned in the Tower during the King's pleasure: made incapable of sitting in Parliament or holding any office of State; and banished from the verge of the Court. The King soon freed Bacon and remitted his fine; but the fallen statesman retired to his estate at Gorhambury, and devoted the rest of his life to those literary, scientific, and philosophic labours which had always been his main interest. His most important philosophical and scientific works are the "De Augmentis" and the "Novum Organum." There are in addition a great many fragments and sketches which throw much additional light on his scientific and methodological theories. Bacon died a martyr to experimental science, and might well be made the patron saint of the cold storage industry. In extremely cold, snowy weather he stopped his coach near Highgate, bought a chicken, and stuffed it with snow, in order to see whether this would preserve the meat. He caught a severe cold, which was aggravated by the damp bed into which he was put at Lord Arundel's mansion, where he had stopped for the night, and he died in his sixty-sixth year.

In order to understand Bacon's dissatisfaction with the science of his time, we must try to imagine a state of affairs in which physics and chemistry were in much the same position as psychology and sociology are now. There were various sects or schools of physicists, following various masters, wrangling with each other, and producing much heat, little light, and less fruit. Existing scientists are divided by Bacon into two classes: (1) the extreme rationalists who rush to wide general principles from a few common-place and badly analysed facts, and then profess to explain everything by means of these principles; and (2) the mere empiricists, who investigate with extreme diligence but no scientific method some small region of phenomena, and then put forward theories of the universe in terms of the small corner of it with which they happen to be best acquainted. Nothing satisfactory can be reached in either of these ways. The theories of the rationalists are more plausible than those of the empiricists, but they lead to no practical results and give us no control over Nature. The empiricists (*e.g.* the alchemists) have sometimes stumbled by chance on useful practical results. But each of these is isolated from the rest, and Nature cannot be controlled practically until its structure and laws are understood theoretically. So Bacon demands that the sciences shall be built up again from better foundations and by a new method, which shall combine the careful observation and experiment of the empiricists with the generality and systematic connexion of the rationalists. Like other philosophers of his time, Bacon made the mistake of thinking that, because a good method is necessary in order to accomplish anything, it is sufficient in order to accomplish everything. He compares it to a ruler or a compass in drawing; and, like Descartes, he thinks that it will reduce all human intellects to a level.

Now Bacon holds that science has so far failed, partly because the human mind has not had an adequate, trustworthy, and properly selected set of data to work upon, and partly because it has not applied a suitable instrument of interpretation to the data which have been available. He thinks the first defect more serious than the second; for he says that important generalisations could be gained even by the present imperfect logical processes from an adequate natural history, whilst even the most perfect logical instrument would be powerless to elicit truth from the present scanty and unreliable data. In order to remedy this evil, Bacon holds that the first necessity is to prepare the mind for collecting a proper natural history and for interpreting and generalising from this history. The mind of any grown man is a highly distorting mirror, and our first business is to plane and polish it as far as may be. The factors, innate and acquired, which cause bias and error are called by Bacon "Idols." Certain of these are common to the human race, *e.g.* the tendency to ascribe to Nature the particular kind of orderliness and simplicity which is pleasing to men. These are called "Idols of the Tribe." Others vary from individual to individual; *e.g.* some men tend to dwell on resemblances and neglect differences, whilst others have the opposite bias. These are called "Idols of the Cave." Then, again, the suggestions and associations of language are a fruitful source of error; since words and phrases embody theories which are often false and observations which are often mistaken. These are called "Idols of the Market Place." Bacon admits that these three kinds of Idol can never be completely eliminated. But we can be put on our guard, so that we allow for them and thus render them harmless. Finally, there are false systems of philosophy and science erected by bad logic on flimsy foundations. These are called "Idols of the Theatre"; and there is no reason why they should not be completely removed, partly by pointing out their fallacies and their unfruitfulness, and partly by substituting good reasoning and properly attested data.

The human mind has, however, many deficiencies

as well as positive sources of error. When the latter—the Idols—have been removed, it is time to provide aids to supplement the former. The senses have two defects. In the first place, they are sensitive only for a small range of stimuli. Secondly, their deliveries are always infected by subjectivity; they tell us of things, not as they are in Nature, but as they affect a particular organism at a particular time and place. The first kind of defect can be remedied to a large extent by suitable instruments. The second can be remedied by comparison between different senses of the same observer, or the same sense of different observers. Bacon holds that the deliveries of the senses, when properly compared, criticised, and neutralised, are trustworthy, and are the only possible foundation of science.

When the mind has been thus purified and helped, it is time to give it directions for collecting a complete natural history. Bacon recognised that the actual collection of such a natural history would be a work which would take much time, trouble, and expense, and in which many men would have to co-operate. He hoped to secure such co-operation, and to confine himself to giving directions and to completing the logical principles for interpreting and generalising the facts. Unfortunately he received no help either in money or in kind, and so he was forced to collect his data for himself, a task for which he was obviously ill-fitted.

Bacon's scheme for a complete natural history was as follows. It was to consist of an account of the normal course of Nature, of abnormalities spontaneously produced in the course of Nature, and of results deliberately produced by the interference of man. Bacon attached very great importance to deliberate experiment as compared with passive observation. He also attached great weight to the observation of spontaneous abnormalities. They set us free from prejudices, and they suggest means of producing new substances and changes artificially. Bacon explicitly recognised that there is no fundamental distinction between natural and artificial products. In the history of the normal course of Nature we are not to neglect what is commonplace or to omit what is filthy. The method of selection is to be the following. Data are to be chosen, not for their intrinsic interest or for their immediate practical usefulness, but for their capacity to throw light on the structure and laws of Nature. Bacon's views on practical applications in science are admirably just. On one hand, he regards the practical control of Nature as the ultimate end of science, and ability to produce observable results as the ultimate test of any scientific theory. On the other hand, he fully recognises that Nature can be controlled practically only by being understood theoretically; and he constantly asserts that to aim directly at particular applications is fatal to pure science and short-sighted even from the point of view of practice.

Bacon gives rules for recording and arranging the data of the natural history when they have been collected. The following are the most interesting. All data that can be accurately measured should have their values recorded; where accurate measurement is impossible, upper and lower limits should be assigned. All difficult experiments must be fully and carefully described, so that others can criticise and, if necessary, repeat them. The data must be tabulated and classified from the very first. But we must recognise that at first the natural history will almost certainly contain some alleged facts which are not genuine, and that our first classifications will be partly inappropriate. If, however, the bulk of the data recorded are genuine facts, they will suffice to establish the general laws and structure of Nature; and, in the light of this, the few errors will stand out as anomalies and can be reinvestigated and corrected. Similarly, it will be necessary to return to the natural history again and again as our knowledge of the general laws and structure grows, and to reclassify the data in the light of this increased knowledge. Probably a work like Beilstein's "Dictionary of Organic Chemistry" would be a good example of what Bacon meant by a natural history. Yet of course the classification of compounds within this dictionary depends entirely on chemical theory, whilst Bacon wanted his natural history to be as free from theory as possible. The solution of this apparent contradiction is that the natural history and the theories induced from it act reciprocally and successively on each other. The first and crudest form of the natural history involves the minimun of theory and gives rise to the crudest inductions. The natural history is now corrected and reclassified in terms of these inductions. It thus imbibes an additional dose of theory, and becomes the basis for more accurate inductions which in turn react on itself.

(To be continued.)

Antarctic Weather.

THE recent publication of Dr. Simpson's interesting Halley Lecture of 1923 focusses attention once more on the little-known causes which are responsible for the weather of the Antarctic continent. In his lecture Dr. Simpson dealt particularly with the meteorological conditions as they affected adversely Capt. Scott's journey to and from the South Pole, and justified Scott's own view that the conditions on the last stage of the return journey were such as could not have been foreseen. This impossibility of forecasting weather conditions is of course shared by the Antarctic continent with many other regions of the earth, but there is some reason for believing that the contrasts in weather conditions from year to year and from day to day are very pronounced, at least in the region of South Victoria Land, to which area these remarks chiefly refer.

A visitor's first sight of the still active volcano forming the summit of the ice-clad Ross Island is indeed prophetic of the contrasts he will later experience; he will be no less surprised to discover that the continent, roughly circular and of radius some 1200 miles, is almost entirely covered with ice and snow, though it could, so far as precipitation is concerned, be classed almost as a desert. The general surface circulation is anticyclonic, the air flowing outward from the continent with an easterly component due to the earth's rotation. Superposed on the normal distribution of wind velocities

appropriate to the anticyclone is a fairly frequent and high south-easterly wind. These blizzards are inclined to commence more suddenly in winter than in summer, and to occur more frequently during the darker months. On the floating Ross Barrier the yearly excess of precipitation over loss from the surface is only some 8 in. of solid ice, on the average. On the plateau, the net gain to the surface is probably a good deal less than this, the gain being balanced approximately by the downward flow of ice in glaciers of various types. The ice covering differs from that in other regions of the globe in that it does not melt appreciably on land and often pushes a floating 'tongue' for many miles into the sea before a point is reached where melting can set a limit to its advance. Practically the whole of the small snowfall must be formed during blizzards; it is also during blizzards that evaporation from an ice surface is a maximum, at least in the winter months.

Though possibly not in the most logical manner, this leads us to consideration of the blizzard of the western Ross Barrier—that blight of English expeditions. On account of its geographical position and the lower temperature of the Barrier, the pressure over it is higher than over the Ross Sea. This causes a preponderance of surface air-flow from the south and east, on the western side of the Barrier; any increase of this pressure difference—for example, in the form of a moving pressure wave—causes a blizzard. Simpson has indeed showed that blizzards occurred in McMurdo Sound, which lies at the north-west corner of the Barrier, when the pressure difference between that place and Amundsen's headquarters, at the north-east corner, increased; high northerly and light southerly winds, or calms, occurring when the pressure difference decreased. Even when no snow is being formed, the air during a blizzard is filled with vast quantities of loose snow scooped up from the surface, and, at the same time, the temperature generally rises. These characteristics and the gustiness of the blizzard suggest a thorough mixing of the cold surface air with warmer air above it. Blizzards may be of short duration or may last a week or longer; that during which Scott and his party perished lasted for at least ten days. The position of a party storm-bound for many days in a tiny tent is not particularly comfortable, especially when the sun is low, and one can readily imagine the earnest—even fierce—and interminable discussions which accompany the blizzard: Is a wind of 60 miles an hour and a temperature of $-30°$ F. worse or better than a wind of 50 miles and a temperature of $-40°$ F.? How much cream goes to the making of cream cheese? Is it better to sleep with the fur side of the sleeping bag inside, or with the skin side inside?

The western barrier blizzard occurs most frequently in the winter and the adjacent months. To appreciate the reason for this, it is necessary to consider the intensity of radiation to and from the surface, bearing in mind that air receives or loses heat chiefly by contact with the surface. On the snow-covered Barrier, the surface is peculiarly sensitive to radiation on account of the low specific heat and low heat conductivity of the loose snow covering, in comparison with the corresponding constants for the sea which bounds it on the north. Over the sea, convection is operative, and there is a normal temperature gradient in the air above it. The same is true over the Barrier when the inward directed radiation is sufficiently intense, the surface temperature being, however, naturally unable to rise above freezing point. When outward directed radiation predominates, the snow surface rapidly cools and an inverse temperature gradient is established in the air above, provided the horizontal air flow is not too great. This results in a large daily amplitude of temperature on the Barrier—a variation which is almost exactly in phase with the sun's altitude. In appropriate conditions, a mean amplitude of 20° F., corresponding to a variation in the sun's altitude from 10° to 30° above the horizon, has been measured, a range which equals the mean daily amplitude in India, where the sun nearly reaches the zenith and is below the horizon for almost twelve hours.

Due to the same causes, the yearly variation of temperature lags only eight days behind the sun. For the summer 1911–1912 the mean temperature on the plateau for the midsummer month was $-9°$ F., with a mean temperature of $-19°$ F. for the following month. These figures are suggestive of what is likely to occur on the plateau in the depth of winter when the temperatures on the Ross Barrier, which is almost at sea-level, fall at least to the minus seventies. Except in summer, the mean temperature of the Barrier is fixed largely by the frequency of the southerly blizzards, each of which causes a rise in temperature. The low Barrier temperatures, which played so great a part in the disaster to Scott's party, were such as could be expected to occur occasionally; what was entirely unexpected was the length of the cold spell, or, in other words, the unusual paucity of blizzards in late February and March. When the blizzard did come, it was of unusual duration and came at a critical time, when the party was within eleven miles of One Ton Depôt.

March and April are probably critical months, since the formation of a permanent winter ice covering in McMurdo Sound seems to be conditioned largely by its ability to reach a sufficient thickness between blizzards, before the winter weather sets in.

Travel on the Barrier at a time when the sun is setting, or has set for the winter, is indeed an unpleasant business, and considerable advantage is gained by choosing a time for the commencement of a long journey so that Christmas falls practically in the middle of the period. Apart from the necessity of avoiding the bad weather of the autumn, one should strive by this means to avoid the bad sledging surfaces associated with low temperatures. We have no quantitative information about the relative friction at temperatures about and far below 0° F., or in fine and coarse-grained snow, but the differences are known to be very important, and the great wear of the sledge runners is quite sufficient indication of the increased friction at really low temperatures. On cold, freshly-fallen snow of a 'floury' consistency the effort of hauling is so great that one has the feeling that the friction is a friction, not between snow and runner, but between adjacent snow grains.

Much more data are required before the weather of the Antarctic can be known in more than its broad outlines—data which can only be gathered by concerted

action and by the permanent occupation of temporary observatories. The present poverty of the country is such that no well-found expedition is likely to be launched in the near future, but the time will come when further information will be urgently required, and this will be the time for insisting on the importance of such conditions as will obtain the fullest scientific value for money expended. It is hoped that the Scott Polar Research Institute, the formal inauguration of which has recently taken place at Cambridge, will have some influence in determining questions of this nature. C. S. W.

Obituary.

PROF. F. W. GAMBLE, F.R.S.

A DISTINGUISHED English zoologist, a remarkably fine teacher and a man of a singular charm of character, has been lost to science by the death, on September 14, of Prof. Frederick William Gamble, Mason professor of zoology and comparative anatomy in the University of Birmingham. He was born in Manchester on July 13, 1869, and was educated at the Manchester Grammar School and at the Owens College. At the College he came under the influence of the late Prof. A. Milnes Marshall, and catching his enthusiasm for the study of animal morphology, devoted himself to zoological studies. After taking his degree with first-class honours in the newly established Victoria University and gaining the Bishop Berkeley research fellowship, he went abroad and studied for a time in the University of Leipzig. The first two papers from his pen, one on our rare British Nudibranchs, published in 1892, and the other on the British marine Turbellaria, published in 1893, were descriptive and systematic in character, but already they showed evidence of the tendency of his mind towards the experimental side of the subject.

After a short period as a junior demonstrator, Gamble was made lecturer and senior demonstrator in zoology in the University of Manchester, and in 1896 he completed his account of the flatworms and Mesozoa for the "Cambridge Natural History," a most interesting and valuable contribution to that excellent text-book. It was about this time that the lug-worm (Arenicola) was introduced as a type in the schedule for the first M.B. examination of the Victoria University; and finding from laboratory experience that the current accounts of the structure of this worm were inadequate and in many respects inaccurate, Gamble and his colleague J. H. Ashworth prepared and published in the *Quarterly Journal of Microscopical Science* a very careful and elaborate description of its anatomy. This study led to the important discoveries by Ashworth, at a later date, of the structure and function of the giant nerve cells and nerve fibres of the Polychæta.

While the work on Arenicola was still in progress, Gamble's interest was attracted to the colour changes in the 'Phantom' shrimp *Hippolyte varians*, and, working now in partnership with a colleague in the botanical department, Mr. (now Sir Frederick) Keeble, a series of experiments were made at the fisheries' station at Piel which led to very interesting and remarkable results. The discovery of a blue nocturnal phase in all the colour varieties of this shrimp was in itself a novel and startling fact, but when the researches were extended to the higher forms of Crustacea, many other very important systematic and physiological results were obtained. In 1903 another paper by the same authors, working on the coast of France, appeared in the *Quarterly Journal of Microscopical Science*, on the bionomics and physiology of the remarkable turbellarian worm *Convoluta roscoffensis*, in which it was proved that the green corpuscles of the Convoluta represent a phase in the life-history of a flagellate organism allied to the genus Carteria, and that this organism infects the eggs after they are laid. It is not an exaggeration to say that this study in symbiosis has become one of the important classics of the subject. It is frequently referred to by later writers as the chief authoritative statement on the physiological relationship of host and guest.

It is not possible in this place to refer in detail to other scientific work Gamble did when this partnership was dissolved. It was characterised by the same love of the experimental method, accurate observation, and cautious deduction that was shown in his earlier writings.

With all his love for scientific research Gamble combined all the great qualities of a conscientious and explicit teacher. He spared no pains to make his lectures and demonstrations effective, with the result that he earned the respect and gratitude of a large number of his pupils and colleagues. In the two admirable little books which he published, "Animal Life" and "The Animal World," he has left some indication of the way in which he presented the problems of biology to an unscientific audience; and his account of the Radiolaria in Lankester's "Treatise on Zoology" shows his power of mastering the literature of a large subject and presenting the substance of it in an intelligible way to the more advanced student.

By the death of Gamble many of us have lost a most sincere and devoted friend. His quiet, modest manner, his constant readiness to help his colleagues and his pupils, and his unblemished character, endeared him to a wide circle of friends and acquaintances. He was elected a fellow of the Royal Society in 1907 and appointed professor of zoology in the University of Birmingham in 1909. He was president of Section D of the British Association at the Toronto meeting in 1924, where he delivered a very interesting address dealing principally with the question of the metabolic gradients.

Gamble married, in 1904, Ellen, daughter of the late Rev. J. M. Bamford, of Arnside, who survives him. He left no children.

WE regret to announce the following deaths:

Prof. Rudolf Eucken, from 1874 until 1920 professor of philosophy in the University of Jena, and author of many works on philosophy, on September 14, at eighty years of age.

Dr. Paul Kammerer, of the Biologische Versuchsanstalt, Vienna, known for his experimental work on the inheritance of acquired characters in amphibia, on September 23, aged forty-five years.

News and Views.

THE report of the Government Chemist upon the work of the Government Laboratory for the year ended March 31, 1926 (London: H.M. Stationery Office, 1926; 1*s.* 6*d.* net), though mainly a statistical document, is a standing witness to the value of this adjunct to the Government services. Unlike their medieval predecessors, Sir Robert Robertson and his merry men are not called upon to produce gold from base metal, to read the stars and to cast horoscopes; their task is the more prosaic but far more practical one of safeguarding the revenue and, to a certain extent, the health of the country, by means of chemical tests. Their work, however, extends beyond this, for in addition to serving the Board of Customs and Excise, the Board of Trade and the Ministry of Health, they do much chemical work for other Government departments, such as the Ministry of Agriculture and Fisheries, the Air Ministry, the Office of Works, the War Office, the Post Office, and the Inland Revenue. Not content, apparently, with these primary duties, the comparatively small staff of the Government Laboratory undertakes occasional research work of no mean importance, and provides representation on a number of scientific committees. Chemical analysis is, however, its main activity, and the number of samples analysed during a year, no less than their diversity, inspires us with a feeling of profound respect, if not of awe. During the year 1925-26, no fewer than 445,606 samples were examined, of which more than 110,000 related to beer and brewing materials, 106,305 to wines, 48,587 to spirits and spirituous preparations, 72,289 to tobacco, 61,003 to sugar and sugar products, 39,391 to tea, and 13,128 to cocoa and chocolate. The number of samples of imported beer, cocoa-goods, and imported spirits and spirituous preparations was considerably in excess of the number analysed in 1924-25.

THE work of the Government Laboratory indicates in no uncertain way the trades that are especially marked out to bear the burden of taxation, and it also reflects important changes in legislation. Thus in the year 1924-25 no samples of silk were examined in the Laboratory, but last year, following the imposition of duties, 12,237 samples were taken and tested, of which 10,313 were from imported materials, 1803 from exports, and 121 from home factories. Developments, industrial and fiscal, in the Irish Free State have been responsible for recent fluctuations in the number of tobacco samples examined. The Safeguarding of Industries Act necessitated the examination last year of 9645 samples of imported goods, whilst the Dyestuffs Act accounted for 195 samples, as compared with 535 in the previous year. Although mainly of interest to the analytical chemist, the report contains many items that will appeal to the student of affairs, and the layman's perusal of it leaves the impression that on the score of impurities and adulterations, the public have little reason to complain. From the large number of miscellaneous samples examined for the Post Office, it is interesting to note that, although 'gold thread' figures in the list, there is no reference to 'red tape'; analyses of lubricating oil for H.M. Stationery Office suggest a welcome acceleration of motion in that department; and the recovery of radium from disused compass-dials, gun-sights, etc., for the Treasury evokes memories of a war, and of a Damocletian weapon in the form of an axe that never fell.

A BRIEF Reuter message from Batavia in the daily press of September 27 announces the discovery by Prof. Heberlein of what is said to be a complete skull of the type *Pithecanthropus erectus*, the well-known Java skull. The discovery was made at Trinil, the village near which Dubois in 1892 found the skull-cap, thigh bone, and two teeth, to which the name *Pithecanthropus erectus* was given and about the human character of which so much controversy has since raged. Should later detailed information confirm the character of the new find, its importance will amply reward the patience, time, and money which have been expended, since Dubois' discovery was made known, on searching the neighbourhood for further relics of this earliest known and most primitive of the human types. Dr. Aleš Hrdlička, the American anthropologist, on his return last year from an anthropological tour of the sites on which relics of early man have been found, pointed out the importance of an early investigation in Java, where he had seen in the hands of natives an abundance of relics of man, apparently of considerable antiquity, which were being lost to science. It is therefore gratifying to note the announcement that the American Museum of Natural History intends to raise funds to carry on the work of excavation.

THE sixth (interim) report of the Sea Action Committee of the Institution of Civil Engineers is dated October 1925, and deals with researches carried out in 1924 or early in 1925. Its publication by the Stationery Office in September 1926 cannot therefore be called premature. The report contains summary reports on the periodical examinations of the steel test-pieces exposed at various harbours, but it is pointed out that "no really definite results can be expected until the bars are taken up for final examination." The experiments on painted specimens are also at an inconclusive stage, but the results are fairly consistent in showing that some of the paints are decidedly better than others. The biological work carried out for the Committee consists in series of experiments on the toxicity of various compounds to Teredo larvæ and to adult Limnoria. It is concluded that "substances that are toxic to Teredo do not necessarily confer any very high degree of protection against Limnoria." No comment is made on the discrepancy between this result and that obtained by the American Committee, the report of which, published in 1924 and summarised at the end of the present one, states that "the toxicity of the various compounds was approximately the same" for Limnoria and for the Teredinid Bankia. Prof. Barger reports that experiments by Dr. C. M. Yonge at Plymouth have

shown that organic arsenic compounds of the type of D. M. (phenarsazine) are the most effective in poisoning the larvæ of Teredo. Tests on adult Limnoria at Edinburgh by Dr. F. D. White proved that it was not specially susceptible to organic arsenic compounds, the most effective substance being fluorenone, which, however, is too expensive for practical use. Dr. Yonge found that the poisons had no repellent effect on the Teredo larvæ, which settled as readily on wood impregnated with D. M. as on untreated wood, although in the former case they were speedily killed by the poison.

THE paper by Dr. Huber-Stockar, formerly chairman of the electrical department of the Swiss Federated Railways on the Electrification of Railways, which was read to the World Power Conference at Basle, is of interest at the present time. Dr. Huber-Stockar points out that when a railway is once electrified it never returns to steam traction. At first sight it is difficult to understand why so many railway companies are hesitating whether to adopt electric traction or not. The delay is due partly to economic considerations. Electrification involves expenditure, and this expenditure is not justified unless the traffic increases. Every new capital expenditure makes the railway more sensitive to a decrease in traffic. Electrification on a modest scale has not much effect on the prosperity of the railway. The hesitation of railway companies is also partly due to the difficulty in deciding which system is the best. State owned railways are as much interested in economic considerations as privately owned railways. In Europe a number of countries have experienced beneficial effects from electric traction which have justified its adoption. Favourable factors for changing to electric traction are cheap electric power and expensive coal and manual labour. The conditions are also favourable when the traffic is heavy and the gradients are long and steep. Dr. Huber-Stockar concludes that no definite and easily applied rules can be given for determining whether a railway is ready for electrification or not. It would be a great help to engineers if details of installations and working results were always given in similar forms, so that they could be readily compared.

THE excavations at Beisan of the Palestine Expedition of the University Museum, Philadelphia, which were resumed on August 24, have already produced finds of importance in throwing light on the extension of Cretan influence in this direction. In the *Times* of September 23, Mr. Alan Rowe, field director of the Expedition, records the discovery of cult objects, one a cylinder terminating in a pig's head, which is compared with and closely resembles a Cypriote vase, a basalt model of a chair of Minoan type, and a model of a table, also of Minoan type. The chair, although Cretan in form, bears Egyptian emblems—a winged Set animal, a vulture with outstretched wings, and the *ded* pillar emblem with arms and hands holding the Sign of Life. These finds, taken in conjunction with those of 1925, which, however, were of later date, point to a strong Cypro-Mycenæan influence in the religion of Beisan from 1375 B.C. onwards, of which the final phase was the Philistine domination ended by David about 1000 B.C. A bronze axe-head with a blade at one end and four curved prongs at the other, is similar to an axe-head held by a king figured on the gate of the Hittite capital in Anatolia. This would accord with the fact that about the time this temple of Amenophis IV. was being built the Hittites were advancing in northern Syria. The discovery of faience objects bearing the cartouche of Amenophis III. below the level of the floor of the temple confirms the attribution of this building to Amenophis IV. (1375-1358 B.C.).

AT the recent meeting of the British Association in Oxford, a registering balloon ascent was made by the Meteorological Office from the quandrangle of Keble College, in the presence of the guests assembled for the Meteorological Luncheon held on August 10. The balloon and meteorograph fell at Caxton, near Cambridge, a distance of 94 km., N.E. by E. The balloon reached a height of 20·1 km. before bursting. The meteorograph employed was a light barothermograph without clock, but it is possible to infer from the known approximate vertical velocity of the balloon that the total time of flight from ground to ground again was about 1½ hours. This indicates an average horizontal velocity of about 18 m. per second. The balloon was seen to enter a cloud of mammato cumulus form at a height of about 1½ km.; the record shows a small lapse rate of 4° per km. just below that height. From this point upward to 3·0 km. the atmosphere was in a slightly unstable condition with regard to saturated air; then there occurred traces of a reduced lapse rate, while above that again slight instability prevailed up to 7 km. It is probable that 3 km. marked the upper limit of the clouds seen from the ground. The stratosphere was found at 9·9 km., with a temperature of 231° Abs., and above that not more than 2° change of temperature, plus or minus, occurred at any point up to the maximum reached. The ascent was made in the south-westerly current to the south east of a depression centred south-east of Iceland, with a gradient wind of about 8 m. per second.

A FUND for research fellowships, to be known as the "Eric Knight Jordan Research Fellowships in Geology," has lately been established by Dr. and Mrs. David Starr Jordan as a memorial to their son, who died on March 10 last. This fund is to be administered by the Stanford University, of which Dr. Jordan was the first president. The founders attach two conditions to the gift: first, that their son's name shall be perpetuated in the foundation; and secondly, that the principal sum shall be forever kept inviolate, only the interest thereon being used. The founders as an initial step have contributed a sum of about 1000*l*., but expect to add to this later on, and invite friends of their son to contribute also E. K. Jordan in his all too short life (1903-1926) had shown great promise. No less than eleven important

papers stand to his name, all published in the last six years. Beginning with one on recent mollusca, followed by a temporary digression into the subject of Hawaiian fishes, the remainder are concerned with the tertiary and quaternary molluscan faunas of localities in Lower California and Mexico, or expeditions in connexion therewith.

PROFS. H. BENNDORF and V. F. HESS are at present engaged in writing a comprehensive treatise on "Atmospheric Electricity and Allied Phenomena," to be published next year. As is well known, the funds available for the libraries of the Austrian universities are far from adequate, and it is extremely difficult to maintain scientific journals, especially the bulletins and proceedings of scientific institutions and societies of foreign countries. Profs. Benndorf and Hess write asking physicists and meteorologists in all English-speaking countries to send them reprints of their publications. Papers are required on atmospheric electricity dealing with the electric field of the earth and atmosphere, atmospheric ionisation, electricity of thunderstorms, electric properties of rain and snow, radioactivity of the earth and atmosphere, rays of cosmic origin, electric currents in the atmosphere, the aurora, theories of the origin of electro-atmospheric phenomena, and propagation of electric waves round the earth. Any reprints on these subjects would be gratefully received; they should be addressed to Prof. Benndorf or Prof. Hess, Physikalisches Institut, Universität, Graz (Steiermark), Austria.

DURING the past summer Prof. G. F. Sleggs, professor of biology at the newly established Memorial University College of Newfoundland and oceanographer to the Newfoundland Government, a former graduate of the Oceanography Department of the University of Liverpool, has carried out biological and hydrographical research in Bonavista Bay, Trinity Bay, Conception Bay, and other important Newfoundland fishery grounds. Samples of water have been obtained from a wide area and from accurately known depths for a study of plankton and temperature variations. A drift bottle experiment has also been carried out, a satisfactory proportion of the bottles having already been recovered. The work is in co-operation with the North American Committee on Fishery Investigations and is the first of its kind to be officially supported by the Newfoundland Government.

AMONG many brightly written and well illustrated articles in the *Scientific American* for September is one on the decreasing level of the great lakes From a diagram, showing the variations in level of Lakes Huron and Michigan from 1860 to the present year, it would appear that apart from minor fluctuations a general lowering of level set in about 1890, after which the level has never reached previous maxima and has generally stood well below previous minima. Since 1909 the level, with one or two exceptions, seems to have been steadily falling. It is now about two feet lower than it was in 1860. The Chicago drainage canal, which was opened in 1900, has a flow of 8800 cubic feet a second, while other canals and artificial outflows from Michigan, Huron, and Erie account for 57,000 cubic feet a second. It is, however, pointed out that during the period 1917–1925, while the lakes stood at their lowest level, the rainfall deficiency over the lakes and their drainage area was at least two inches a year, and in some areas in certain years rose to six inches. Thus it is by no means certain that canal construction has been entirely to blame in robbing the lakes of water, though, if the decrease continues, the construction of weirs will become necessary.

IN view of the recent discussion at the British Association, attention may be directed to a brief historical review of the question of the species concept by Fridthjof Okland in *Naturen* (1926, pp. 75-87). From this he draws the following conclusion : " Even if we realise how uncertain the species concept is, biologists can and must continue to work with some such delimitation of forms. At the same time the obvious hopelessness of finding any biological concept of the species that shall be universally applicable gives distinct proof that the limits between forms are often more apparent than real. Our classification does not always give a true picture of relationships and connexions in living Nature." On which one is impelled to ask : Can it, and should it ?

THE twenty-fourth annual report of the Rhodesia Museum, Bulawayo, for 1924, records the appointment of Mr. A. Frost to the post of geologist, vacant since 1915. Mr. Frost arrived soon after the discoveries of platinum ore in the Transvaal and found his time almost entirely occupied in reporting on samples submitted by prospectors. A special platinum exhibit was arranged, illustrated by maps and sections. A platinum panning, supplied by Mr. Milligan, of the Anglo-French Exploration Co., is available for prospectors to see and 'tail out' for themselves. It is to be hoped that some of the many who receive assistance will become members of the Museum, which is so poor that it does not possess even a rock-cutting apparatus.

THE Meteorological Department of the Government of India issued during the early part of August a forecast of the probable amount of rainfall during August and September, together with a memorandum on the rainfall experienced in June and July. The monsoon was very weak in June but normally active in July. The June rains were generally in defect, but in July there was a marked improvement. The inferences from the data most likely to have influence on the rains of August and September, show that the monsoon rainfall of the two months is likely to be normal in north-west India and normal or in excess in the Peninsula. Forecasts which are required by the Indian Government were issued by Mr. J. H. Field, Director-General of Observatories.

THE Atlantic weather, which has been brought to general notice more than usual of late by the disastrous hurricane in Florida and the West Indies, is thoroughly discussed in the *Marine Observer* published by the Meteorological Office, Air Ministry.

Research Items.

ANCIENT BRONZE FROM THE TRANSVAAL.—At the meeting of the South African Association for the Advancement of Science held at Pretoria in July last, Mr. Percy Wagner presented a communication on the making of bronze by the ancient inhabitants of the Transvaal, which is published in the *South African Mining and Engineering Journal* of July 26. Tin mining and smelting were practised by an unknown people in the Transvaal long before the advent of the whites. Some years ago a lump of bronze was found alongside a furnace on a farm, Blaauwbank No. 433, about 40 miles west of Warmbaths. The bronze was remarkable in that it included 3 per cent. nickel and 2 per cent. arsenic. Some regarded this bronze as an accidental product due to the reduction of a composite ore; but a recent discovery has placed it beyond question that the ancient miners deliberately set out to make bronze. Recently on the same farm, Blaauwbank No. 433, have been discovered near a dry watercourse, thirty distinct smelting furnaces, with hand-cobbed tin and copper ore alongside. 'Slugs' and 'frills' of bronze were found in the furnaces. In regard to the presence of nickel in the bronze, there is at Blaauwbank a nickel lode carrying at the outcrop masses of apple green 'nickel-bloom' which remotely resembles malachite. The accidental introduction of this material may have led to its continued inclusion intentionally when its special qualities had been appreciated. The point is one of considerable archæological interest, as it is stated that no other ancient mines are known that could have furnished in one locality the ores for producing a nickeliferous bronze, and a nickel-bronze was known and in use in early Mesopotamia and Egypt.

THE FAMILY 'TRINITY.'—In *Man* for September, Prof. Radcliffe-Brown puts forward an interesting theory to account for the relations of father, mother, and child in the primitive family. It has been pointed out that the natives of Murua (New Guinea) regard the incidence of childbirth as in the nature of a welding of personalities—a trinity of father, mother, and child. But this same conception is found among a great many primitive peoples. In the Andamans, for example, the family does not really exist as a properly constituted group until the birth of the first child—the relationship between husband and wife is not simply created by marriage. It is illustrated by teknonymy, the custom whereby one of the spouses addresses the other as "mother of," "father of" the child. The imposition of a special taboo points in the same direction. It differentiates the family as a group. It is only the first child that counts, the later born children being regarded as multiples of a single personality. This principle operates also in the polygynous family, where either the wives are, like the children, multiples of a single personality, especially if they are sisters, or the husband is separated into a number of units, each with a wife and her children—the form typically taken by the polygynous family in Africa. The other method, however, may be adopted there also, when a man marries two sisters, or where a wife is childless and another wife is obtained to bear children. The same principle applies to polyandry, but only when the husbands are brothers.

THE TABANIDÆ OF THE CANADIAN PRAIRIE.—The biology of the blood-sucking flies belonging to the family Tabanidæ forms the subject of a recent paper by Prof. A. E. Cameron in the *Bulletin of Entomological Research* for July 1926 (vol. 17, Part I.). Hitherto most of what is known concerning these insects in North America has emanated from the United States, and information concerning the Canadian forms is very meagre. The genus most abundant in species is Tabanus, its most prevalent member being *T. septentrionis*. Of the genus Hæmatopota there appears to be but a single representative, *H. americana*, while the most abundant species of Chrysops is *C. mœrens*. Previous to the settlement of western Canada, the principal hosts of Tabanidæ were the larger game animals. The moose, deer and elk are still to be found in the northern regions where the white settler has not penetrated, and, along with the barren-ground caribou, these animals are the chief native hosts of prairie Tabanidæ to-day. In cultivated districts they attack live-stock and human beings indiscriminately. The theory that Tabanidæ are the insect-transmitters of infectious anæmia of horses appears to be very uncertain and requires critical investigation, as the disease may be rife on one farm, while on adjacent farms, which enjoy apparently similar environment, the animals may be devoid of any symptoms of the complaint. Tabanidæ are well known to be strong fliers, and if they do convey the disease it would appear that not all horses are equally susceptible to infection. Prof. Cameron discusses the technique of rearing the larvæ of these insects, and describes and very clearly figures both the larvæ and pupæ of a number of species.

NEW PLANT ILLUSTRATIONS.—In *Curtis's Botanical Magazine*, vol. 151, part iii., Dr. Stapf figures and describes nine new Asiatic plants now in cultivation, namely, *Actinidia kolomikta*, *Rhododendron saluenense*, *Jasminum Beesianum* (which bears beautiful glossy black berries in cultivation in England), *Polygonum campanulatum*, *Pyracantha atalantioides* figured in flower and *P. yunnanensis* in fruit, *Primula siamensis*, *Berberis lycioides* which has the additional attraction for the cultivator that its decorative 'barberries' make a delicious jam, and *Fritillaria Oliveri*. In addition, a Spiranthes is described from the Argentine, a beautiful Cordyline from New Zealand, a Mammillaria from Mexico and a Mesembrianthemum from South Africa, but this distribution of the new records of cultivated plants shows the preponderating influence of new introductions from Asia in our gardens at present.

BURR-KNOTS ON APPLE AND CROWN GALL.—Certain varieties of apples have on their stems, generally at nodes, tumour-like swellings which sooner or later pass over into a crowded mass of wart-like projections. Some of the apple stocks most frequently used in England bear these 'burr knots,' and such stocks have been forbidden entry into the United States under the assumption that these structures were a form of a pathological condition known as 'hairy-root,' which has been found to be associated with the crown-gall organism *Bacterium tumefaciens*. Probably all British workers will, however, endorse the conclusions of R. G. Hutton, H. Wormald and A. W. Witt, in the *Journal of Pomology and Horticultural Science* (vol. 5, No. 3, July 1926), that these structures indicate the position of dormant, stem-borne root initials, and that if placed under moist conditions they will readily give rise to roots. One American worker, C. F. Swingle, has recently published a similar view, and the British workers publish a useful bibliography of earlier references to these structures, which, however, omits the important paper by Dr. A. W.

Borthwick (*Notes from Royal Bot. Gard., Edinburgh*, vol. 16, 1905), in which valuable anatomical data are supplied. Dr. Borthwick's paper supplied practically conclusive evidence that these structures were really root initials, but in view of the American point of view, it is good to have this later confirmation that all attempts to isolate a pathogenic organism from burr-knots have given negative results.

STATISTICS OF FIELD EXPERIMENTS IN AGRICULTURE.—The growing importance of field experiments in agriculture has led to the development of technique for eliminating errors of experimentation, and R. A. Fisher (*Journ. Minis. Agric.* 33) has investigated statistically the relative value of different methods of arranging field plots. A valid estimate of error can be obtained by finding the standard error, the square root of the variance, and a method of replication has been devised whereby this estimate can be obtained from the actual yields of the trial year. Great care is necessary that the arrangement of unlike plots shall be such as to provide a valid estimate of error, and a random arrangement appears to be the most suitable. For simple trials in which every possible comparison is of equal importance, the Latin square provides the most efficient arrangement, one Latin square being selected at random out of the total number possible. For more complex experiments in which comparisons involving single factors—*e.g.* with and without phosphate—are required, replication of randomised blocks is necessary in order that no possible interaction of the factors may be disregarded. With this method the conclusions drawn from the single-factor comparisons will be given, by the variation of non-essential conditions, a very much wider inductive basis than could be obtained by simpler methods without extensive repetitions of the experiment.

GRAVITY DETERMINATIONS AT SEA.—In 1923 Dr. F. A. Vening Meinesz made a submarine voyage from Holland to Java by way of the Mediterranean and the Indian Ocean. Gravity observations were made at thirty-one points, and the results of their isostatic reduction (carried out by the U.S. Coast and Geodetic Survey) were presented at the recent annual meeting of the American Geophysical Union. The average anomaly for all the stations with regard to sign is 0·012 dyne by the Bowie formula. It is of special interest that for ten stations in the Indian Ocean far from land the average anomaly is 0·009. Thus isostatic equilibrium beneath the Indian Ocean is as perfect as it is under the continental regions that have so far been investigated. Dr. Meinesz made additional submarine observations between Holland and Port Said in 1925, and these are now being reduced in America. At present Dr. Meinesz is continuing his work in a submarine voyage to Java via the Atlantic, the Panama Canal and the Pacific. Special attention is being devoted to the continental shelves and the oceanic deeps.

MAGNETIC SURVEY OF FRANCE.—An account of the latest magnetic survey of France, begun in 1921, is given by A Baldit in *La Nature*, August 21, 1926; it is hoped to complete the survey this year. Earlier surveys of France were made by Lamont (in 1856–7, with 44 stations), Perry (33 stations, 1868–9), Marié-Davy (20 stations, 1875), and Moureaux. The latter made two surveys, one including 80 stations (1884–1885), the second, extending over eight years, 1888–95, being much more detailed, and including 617 stations. In regard to the density of the network of stations, the latter was the first survey of France approaching modern standards for a civilised country. It revealed many hitherto unexpected irregularities in the isomagnetic lines, some of which could be correlated with geological features of the country. The present survey is still more detailed, being intended to include 1440 stations; these are not uniformly distributed, being specially dense where the magnetic features of the country are of particular interest. Six observers have been engaged in the work since 1922. The instruments used are not new, and are of standard type, the magnetometer being of Mascart's design, and the inclinometer of d'Abbadie's. The accuracy anticipated is to 1′-2′ for declination, 2′ in dip, and about 20 γ in horizontal force. The period of the survey is one of magnetic calm, and the accidental errors due to disturbance are therefore minimised.

ATLANTIC OCEANOGRAPHY.—A summary of the important oceanographical work of the German *Meteor* expedition of 1925 is given by Dr. H. R. Mill in the *Geographical Journal* for July. The object of the expedition was to survey the ocean depths, including physical and chemical work, of the South Atlantic between lat. 20° S. and the Antarctic circle. The most important work began in June 1925 with the first cross-section of the Atlantic along the parallel of 40° S. from South America to Africa. Profile II. was westward along the parallel of 29° S. Profile III. was eastward on the parallel of 48° S. Then followed Profile IV. westward along the 35th parallel, and Profile V. eastward along the 55th parallel with a dip southward to lat. 64° S., where a sounding of 4380 fathoms was obtained somewhere to the east of South Georgia—the exact position is not yet published. Finally Profile VI. was run west along the Tropic of Capricorn. Echo soundings were checked from time to time with wire soundings. Bottom samples, serial temperatures, and salinity observations were taken throughout the voyage. The upper air was investigated with kites and pilot balloons. The full results of this expedition will throw much light on oceanographical problems in the Southern Ocean.

ELECTRIC LAMP FIRE-DAMP DETECTOR.—It is nearly fifty years since Mr E. H Liveing first designed a method for measuring fire-damp in mines by sending an electric current through two spirals of platinum wire over one of which the mine air was passed: the increased luminosity produced by the combustion of the methane-air mixture on the heated wire gave a measure of the methane present in the air. The apparatus in skilful hands would certainly measure fire-damp, but its value lay rather in its promise than its practical utility. The Liveing principle has been the foundation on which many inventors have built, and has lately been embodied in the electric-lamp detector of Messrs. C S. W Grice and A. G. Gulliford. In the new detector the current of the lamp accumulator can be switched through a small length of fine platinum wire in a chamber to which the mine air has access through a wire mesh. The length of fine wire—3 mm.—between its metal clamps is so adjusted that the wire fuses when the methane reaches 3 per cent. of the atmosphere: below this percentage the wire glows brightly and indicates the presence of gas. It is evident that the utility of the invention will depend on how far the conductivity of the wire and the voltage of the accumulator can be maintained constant under working conditions.

SWEDISH RAINFALL.—In the note in NATURE of August 28, p. 318, on the Swedish rainfall statistics for 1925, the fact was overlooked that the means for each month and for the year are compared with the figures for 1925, which adds to the value of the volume.

The Alloys of Aluminium and Silicon.

THE very great interest at present being taken in the aluminium alloys containing from about 10 per cent. to 13 per cent. of silicon, is shown by the fact that no less than three of the papers presented to the Institute of Metals at the recent meeting at Liège dealt with this material.

Both from the practical point of view, regarding the material as one of considerable promise for the production of light alloy castings, and from the theoretical, these alloys are of more than usual interest. It has been known for some time that the structure may be greatly affected by the addition to the molten metal of small amounts of various 'modifying' reagents. Many theories concerning the reason for this change of structure have been propounded, but, hitherto, no completely satisfactory hypothesis has been available. Figs. 1 and 2, reproduced by courtesy of the Institute of Metals, illustrate the change in structure of the 10 per cent. alloy brought about by the addition, at 750° C., of 5 per cent. of sodium hydroxide. Fig. 1 represents the material in the ordinary chill cast state, and Fig. 2 the same after the 'modifying' treatment. The mechanical properties also are greatly improved when the alloy possesses the second type of structure.

Fig. 1.—9·86 per cent. Si, 0·45 per cent. Fe. Chill cast. Unetched. × 200.

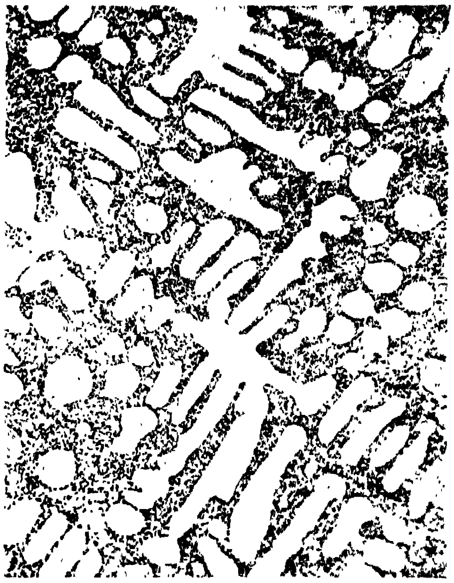

Fig. 2.—9·86 per cent. Si, 0·45 per cent. Fe. Same alloy as Fig. 1, but modified with 5 per cent. NaOH at 750° C. Chill cast. Etch HF. × 200.

Of the three papers now before us, that by Dr. A. G. C. Gwyer and Mr. H. W. L. Phillips (with an appendix by Dr. Stockdale and Mr. I. Wilkinson which is concerned with the mechanical properties of the alloys) is the most important The properties of the material in the 'normal' condition are not very remarkable, but the addition of a small amount of a suitable metal or salt to the melt before it is poured endows the casting with far superior strength and ductility.

In the normal state these alloys consist of a simple eutectiferous system, with small limits of solid solubility at each end. The thermal-equilibrium diagram has been redetermined, and the eutectic point placed at 11·7 per cent. of silicon and at a temperature of 577° C. After 'modificatior' the eutectic contains an appreciably greater amount of silicon and is formed at a lower temperature, both the composition and the temperature being dependent on the rate of cooling and the treatment of the metal. Further, when the molten metal is stirred or remelted after 'modification,' or left in the molten state for an undue length of time after the addition of the modifying material, the normal structure and properties are obtained.

There are clear indications, therefore, that the 'modified' metal is in an unstable state. The authors mentioned now offer a new explanation of their own, which appears to approach far more nearly to the truth than anything which has yet been suggested.

This theory may be briefly stated as follows: When the aluminium-silicon alloy is raised to a temperature considerably higher than its melting point, it is probable that the silicon and aluminium are in true solution. When solid the greater portion of the silicon is present, dispersed in crystals of a size readily visible under the microscope. A small quantity, of the order of 0·5 per cent. at room temperature, remains in solid solution in the aluminium, but this may be disregarded at the moment. In solidifying, the silicon and aluminium pass from atomic dispersion to the crystalline form. At some stage during the process, therefore, the silicon and aluminium aggregates will be of colloidal dimensions. It is well known that the colloidal state is an unstable one, and that colloid particles tend to coalesce. Their rate of growth may be accelerated or diminished by the addition of protective agents.

Having regard to all the facts which have come to light, it appears to the authors that the most satisfactory explanation of the behaviour of 'modifying agents' is to assume that they function as colloid protectors. They do not, of course, confer complete protection upon the colloidal silicon and aluminium, but simply retard their aggregation. From the changes in the crystalline form of the constituents brought about by the process of 'modification,' it is probable that the protector itself is a colloid. It does not, however, appear that the assumption is

justified that when sodium compounds are used for 'modifying,' the protector is necessarily metallic sodium. As a result of this action, the formation of the normal eutectic is inhibited, and aluminium continues to be precipitated from the metal until the super-solubility line is reached.

It is also shown that the protection of the modified structure can be obtained without the use of the ordinary reagents provided that the rate of cooling is sufficiently rapid.

From the theory that certain substances hinder the aggregation of the colloid particles, it should be possible to discover also other substances capable of accelerating this aggregation. The compound $FeAl_3$ is such a substance, and it has been experimentally substantiated that the presence of iron in melts of these silicon-aluminium alloys is detrimental.

A diagram has been drawn up for the 'modified' alloys indicating the manner in which under-cooling alters the normal process of solidification. The amount of the substances added to effect the 'modification' has been considered, and with sodium hydroxide, and for an alloy of about 12 per cent. of silicon, it is put at about 5 per cent. of the weight of the metal. Excess results in a deterioration of the mechanical properties.

The time which is allowed to elapse between the addition of the castings is also of importance, and, for the usual composition of alloy, should be about half an hour.

Since the general theory propounded is independent of any special constituent, it should be sufficiently general to apply to systems other than that immediately under consideration. This is shown to be the case, and exactly analogous results have been obtained in the systems copper-aluminium, aluminium-nickel, aluminium-manganese, lead-antimony, and copper-antimony.

The importance of the colloidal state in alloys at the moment of solidification, and of under-cooling, is thus shown to be far greater than has hitherto been generally appreciated. F. C. T.

The Twelfth International Physiological Congress in Stockholm.

EACH international congress, as a rule, discloses some special interest in one or another field of physiological science, as well as serving as a sure guide to the virility of the science in general. Contrasted with the last congress, held three years ago in Edinburgh, the present congress had no one central interest comparable to that excited by the isolation of insulin, but the fine attendance of the foremost representatives, with a considerable number of the younger workers, from all the continental European countries, was a welcome evidence of the general recovery of physiology from the devastating effects of the War, and of the steady and persistent advance in almost every branch of this science.

The congress in Stockholm was as beautifully arranged as in Edinburgh, and as regards the welcome and hospitality offered there is no need to say more than that it could not have been bettered. The scientific programme of the congress opened with an address by Sir Frederick Gowland Hopkins on "The Mechanisms of Biological Oxidations," in which he outlined the position attained by workers in this field, with especial reference to the work done in his own laboratory at Cambridge.

The routine work of the congress was divided into four sections which were grouped according to subjects, facilitating the attendance by each member at the discussions on those papers in which he was particularly interested.

Great interest was aroused by a number of papers dealing with the fundamental processes of life, as, for example, the communications of the recent important researches of Adrian upon the afferent impulses conducted by the single nerve fibre, and of Hill and Downing upon the measurement of heat production in nerve. An interesting summary was given by Kato (Tokyo) of his theory of decrementless conduction in the narcotised region of nerve, in which, as is well known, he is opposed to the findings of Keith Lucas and Adrian. The problem was the subject of a lively debate, and is probably now near to solution. Muscle physiology was represented by Embden, by Hill, and by Meyerhof.

Another point of great interest was the question with regard to tissue metabolism, mainly represented by Dale's school, in relation to insulin and to such problems as the development of rigor.

In the realm of the central nervous system, an interesting communication was made by Samojloff (Kasan) upon the nature of spinal inhibition. His experiments tend to support the theory of a liberation of some chemical substance affecting the synopses or the cellular structures in the spinal cord. Magnus (Utrecht) made a further contribution to the subject of local and segmental reflexes in the decerebrated animal.

Metabolism was represented by Lusk and Benedict, Boothby, Knoop, Mendel, Noyons, and de Barenne. A noteworthy tendency lay in the simplification of technique, and the applicability of the new methods to clinical practice. A summary was given by Mann (Rochester, Minn.) of his work on the dehepatised animal. Interest in the question of vitamins seems recently to have diminished, very few communications being made.

The study of digestion has now definitely shifted out of the hands of Pavlov's school to America, from whence the pupils of Carlsson, and particularly Ivy, brought communications dealing with the phases of gastric and pancreatic secretion.

Circulation was represented from America by Wiggers (Cleveland), who discussed the fractionate nature of ventricular contraction. The British school was represented by Anrep, who gave papers upon the central and reflex regulation of the coronary circulation (mainly in regard to the innervation of the coronary blood vessels), and upon the electrical measurement of coronary circulation during the single cardiac cycle. Heymans (Ghent) communicated the results obtained with his method of cerebral perfusion as applied to the study of the respiratory and cardio-inhibitory centres. Frédéricq (Liège) summarised the results of his recent work upon chronaxie, especially in relation to the influence of the vagus and sympathetic cardiac nerves.

Prof. Loewi (Graz), in one of the most interesting papers of the congress, gave an account of the various factors affecting the rate of destruction of the chemical substance determining the inhibitory action of the vagus upon the heart. The work of this school would seem to bring us one step nearer to comprehension of the ultimate mechanism of peripheral inhibition.

An important contribution to the problem of hæmophilia was made by Howell (Baltimore), who brings evidence that the determining factor in this condition lies in an unusual stability of the blood platelets. In a second communication, Howell discussed the chemical nature of the anti-coagulant

substance heparin, which is so largely and successfully replacing hirudin in the experimental laboratories of the United States and Great Britain.

With regard to the chemistry of blood, Nicloux (Strasbourg), although unfortunately unable to be present in person, contributed a new spectroscopic method for the determination of small quantities of carbon monoxide in gas mixtures, applying his method to the determination of minimal quantities of it in blood. In a further paper this author presented a new determination of the oxygen content of methæmoglobin, fixing it at half the oxygen content of oxyhæmoglobin of the same blood.

In the present congress demonstrations played what might perhaps be called a secondary part. Many, such as those of Adrian, Kato, and Hill, were in demonstration of communications. Especially interesting in this group was a demonstration by Brinkman (Groningen) of his method of registering the attainment of pH equilibrium in H_2CO_3-bicarbonate buffer solutions. Barcroft gave a summary of his recent work on the spleen, supplemented by a demonstration. This seems, at last, to find some definite and important physiological function for an organ which has baffled physiological thought for centuries. Lim (Peking) gave a demonstration of a dog with transplanted stomach. Of especial interest also was a demonstration by Y. Henderson (New Haven) of his method of measuring the circulation by inhalation of ethyl iodide This seems to be the simplest and most tangible method up to the present, and most probably will find a great future application.

America, as in eleven successive congresses previously, sent a strong contingent of workers, and as was only as fair as it was unanimous, the twelfth congress accepted the invitation of the American Physiological Society that the thirteenth congress be held in America in 1929.

It is, perhaps, of especial interest to mention also the good attendance from Russia, showing that the worst period in that country is approaching an end. Dr. Orbeli (Leningrad), who was present, did not, unfortunately, submit any summary of the results of his experiments upon the sympathetic innervation of voluntary muscle, a problem on which we know him to have been engaged for several years. Prof. I. P. Pavlov, the *doyen* of the congress, showed no sign of diminished activity in spite of his advancing years. There were no communications from his laboratory, although he informs us that a full description of his work on the cerebral cortex is being published in English towards the end of the present year.

The thanks and appreciation of all the members of the congress to their colleagues and hosts in Sweden was expressed by Profs. Gley, von Frey, and Starling at the final meeting of the congress at Upsala, and also previously and more lightly by the same representative speakers at the banquet given to the members of the congress by the City of Stockholm.

The Geological Search for Oil.

ONCE more the ubiquitous problem of the origin of petroleum is forced on our attention, this time as a practical matter rather than as a philosophical thesis. Dr. Murray Stuart writes a paper in the recent issue of the *Journal of the Institution of Petroleum Technologists* in which 'working hypotheses' in the geologist's search for oil form the main theme, the principal argument being that all exploration for petroleum is handicapped at the outset by the fact that little, if anything, is known concerning its origin. We appreciate the laws governing migration and accumulation of oil; we contemplate favourable geologic structures, providing the strata involved are oil-bearing, which are located with remarkable precision; but unless the oil manifests itself by seepage or in some indirect manner, there is little to guide the search. To this extent, it may be noted, the geology of petroleum differs from the geology of, for example, metalliferous ore deposits.

One of the earliest and best known working hypotheses in oil-geology is that attributable to David White, whereby the degree of progressive devolatilisation (or metamorphism) of coal is interpreted as a measure of the chances of obtaining oil or gas in commercial quantity in associated deposits, the percentage of fixed carbon (pure coal basis) being the determining factor. White's law has found ample vindication in the West Virginia oil-fields, but it is not of universal application, as pointed out by Wade in a recent paper on "The Search for Oil in Australia"; the author, however, seeks to amend the law to the extent of excluding the idea of subsequent 'metamorphism' in favour of carbon ratio variation being interpretable in terms of normal processes of sedimentary deposition. He visualises his carbonaceous material as part of a sheet of sediment in which transition from conglomerate ". . . through sand and shale to oil-bearing shale, . . . through something equivalent to Torbanite into more or less pure carbonaceous material . . ." is perceptible; carbon ratio variations are thus functions of original influences (mother substance, environment, etc.), not of subsequent change in the course of geologic time. From this point of view is deduced the hypothesis that, assuming the carbon ratio of a fresh-water or estuarine coal seam to be favourable (*i.e.* 50 to 55), the seam will probably pass through torbanite into oil shale when traced in the direction from which the material composing the seam was initially derived. In the case of coals deposited under marine conditions, lateral variation into petroleum or into oil-shale (depending on the nature of the organic material incorporated in the sediment) is probable. A further hypothesis states that ". . . when formations containing abundant fossil-wood occur the underlying marine formations may contain liquid petroleum," and has been reasoned by the author in previously published papers.

The occurrence of oil in dolomitised limestones of lagoon formation furnishes the author with a contrasted, though in some respects parallel, line of argument; he examines this environment from a biochemical point of view, directing attention to the rôle of foraminifera and other protozoa, and also bacteria, in promoting essential mother-substance, whence he formulates the hypothesis that "all dolomitised limestones of lagoon formation are worthy of thorough investigation, provided that they prove, on microscopic examination, to be foraminiferal."

What we may term the 'coal-to-conglomerate' hypothesis of the author raises problems at least as controversial as those of the origin of petroleum itself, though there is considerable novelty, if not practical import, in the views he puts forward. For the "many examples known in the world of coal seams and lignite seams passing laterally into either oil-shales or oil deposits" there are as many in which no coal-oil association is apparent. The tracing of a coal seam into an oil-shale seam in existing economic circumstances would be little reward to the geologist

bent on locating commercial oil-pools; but the chances of lateral variation from coal to petroleum would seem, according to the author's reasoning, to be somewhat localised. On the other hand, where coal, lignite, or torbanite is in evidence in deposits suspected or proved to contain oil, the hypothesis clearly merits the test: only by this method and in several different cases will its validity, hence its practical value, be established.

University and Educational Intelligence.

CAMBRIDGE.—The John Winbolt Prize has been awarded to H. Bateman, Trinity College, and R. J. Smith, St. John's College, for a joint dissertation on a theoretical investigation of some elastic problems in thin rectangular plates.

EDINBURGH.—In the Royal Botanic Garden, on Tuesday, September 21, the Right Hon. Sir Herbert Maxwell unveiled a tablet to the memory of the late Sir Isaac Bayley Balfour, who was Regius Keeper of the Garden from 1888 until 1922.

THE Wigan and District Mining and Technical College sends us a Calendar giving, in 142 pages, particulars of courses, some of them leading up to the final degree examinations of the University of London, in mining, mechanical and electrical engineering, chemistry, physics, mathematics, building trades, cotton technology, commerce, art, and art crafts. In 1925 six students obtained University of London degrees. Among other specialities is a two-years' Post Office engineering course.

THE London School of Economics and Political Science announces in its summary programme for 1926–27 a series of important public lectures by eminent authorities, open to the public without fee or ticket These include, in addition to single lectures by Profs. Laski and de Paula and Mr. William Cash, a series of three by Prof. Toynbee on international history since the War, six by Prof. Salvemini on Italian communes in the thirteenth century, ten on office machinery, and twelve on accounting in public offices.

THE Battersea Polytechnic's prospectuses for 1926–27 offer full day and evening courses in preparation for the University of London's intermediate and final degree examinations in science, engineering, and music. In consultation with the Incorporated National Association of British and Irish Millers, the London Flour Millers' Association, and the Board of Education, a two-year day course in science and engineering with special reference to the flour milling industry has been organised. Courses for health visitors and sanitary inspectors and in arts and crafts are provided. A separate prospectus deals with the Polytechnic's Domestic Science Training College. Another of London's Technical Colleges from which we have lately received a prospectus is the Cordwainers'. This provides both day and evening courses in the technology of boot and shoe manufacture and leather goods manufacture.

THE East London College announces in its calendar for 1926–27 the institution of a fund for the encouragement of original investigation by the staff and students, and an important addition to its resources for such purposes in the form of a bequest by the late Sir Sidney Lee of 5000*l*. for bursaries for post-graduation work in English literature. Three research studentships of the value of 50*l*. each for one year are awardable annually in July to students completing a three-years' course at the College. Special and advanced lectures announced include: a course of six on short electric waves in wireless, by J. H. Morrell, and six (for graduates) on biology of fresh-water algæ, by Prof. Fritch and Dr. Carter. In its recently constituted department of dramatic study and research there will be a weekly seminar for collective work on a dictionary of British drama. In aeronautical engineering a three-years' course is arranged, and students attending the last two years of this are able to take aeronautics instead of hydraulics in the new subject, 'Mechanics of Fluids,' in the B.Sc. (Engineering) degree examination. The College Council has recently purchased the freehold of a house in South Woodford for use as a hall of residence for men students. One for women students on the borders of Epping Forest with accommodation for thirty-two has already been opened.

THE Northern Polytechnic, Holloway (formerly Northern Polytechnic Institute), gives, in its prospectus for 1926–27, particulars of its important Department of Chemistry and Rubber Technology. It is the only institution listed under the heading of rubber technology in the Universities Bureau's summary of specialist studies in the universities and university colleges of Great Britain and Ireland. The courses are carried on in collaboration with the Institution of the Rubber Industry and provide suitable preparation for students proposing to enter for the examinations for the associate diplomas (A.I.R.I.) awarded by that body. An influential committee, representative of all sections of the industry, co-operates with the governors, and the workshops contain a full range of modern experimental rubber-plant. In addition to the advanced courses there is a Rubber Trades School, for boys of 14 or 15 years of age. The technical chemistry three-years' courses are designed for prospective analytical and works chemists. They include chemical technology, glass-working, chemical engineering, and (a two-years' course) plumbing. A series of important special public lectures have been arranged for the coming session, beginning with one by Raymond Unwin on October 14 on town planning.

THE Municipal College of Technology, Manchester, has resumed publication of its *Journal*. Volume 12, just issued, records investigations undertaken by members of the College between 1919 and 1924. It contains original articles on: losses in resistance connectors in single-phase commutating motors (Miles Walker), the discharging capacity of side weirs (G. S. Coleman and Dempster Smith), the aromatic character of the glyoxaline nucleus (F. L. Pyman), ferrous materials and corrosion (E. L. Rhead), values of the smallest zeros of harmonic functions (J. Prescott and H. V. Lowry), a null method for ionisation potentials (L. S. Palmer and W. Hubball), and a direct-reading refractometer (A. Adamson). The prospectus of the College for 1926–27 shows that since 1919–20 from ten to thirteen research scholarships have been awarded by it each year. The scholarships are open to graduates of any university in the British Empire and other persons possessing special qualifications for research. In awarding three of them, preference is given to Manchester ratepayers and their sons and daughters. Courses of advanced study and research are offered in mechanical, electrical, municipal, and sanitary engineering (including sea outfall and coast defence works), applied chemistry (including textile fibres, paper manufacture, metallurgy, rubber, brewing and allied industries, coal tar and dyestuffs, photography and photographic processes), textile industries, applied physics, and mining engineering.

Contemporary Birthdays.

October 5, 1861. Sir Thomas L. Heath, K.C.B., K.C.V.O., F.R.S.
October 7, 1842. Sir Philip Magnus, Bart.
October 8, 1850. Prof. Henry Louis le Chatelier, For. Mem. R.S.
October 8, 1857. Sir Richard C. Garton, G.B.E.
October 9, 1879. Prof Max T. F. von Laue.
October 9, 1863 Prof. Albert Charles Seward, F.R.S.

Sir THOMAS HEATH, who was born in Lincolnshire, was educated at Caister Grammar School and Clifton College, passing thence to Trinity College, Cambridge, where he graduated 12th wrangler, whilst also acquiring distinction in classical studies. Entering the public service, he was early attached to H.M. Treasury, fulfilling successively the highest offices. Since 1919 he has been Comptroller-General, National Debt Office. Among many dissertations and works, he is the author of "A History of Greek Mathematics" (2 vols., 1921). Sir Thomas is an honorary fellow of Trinity College, Cambridge, and Hon. D.Sc. Oxford.

Sir PHILIP MAGNUS, to whom very hearty congratulations are due on the approaching anniversary of his eighty-fourth birthday, was educated at University College School, graduating thence at the University of London. Organising director and secretary of the City and Guilds of London Institute from 1880 until 1888, he was afterwards and for nearly thirty years the able and zealous secretary of its Technology Department.

Prof. LE CHATELIER's name is associated with important discoveries in several branches of chemistry. In conjunction with Mallard he conducted elaborate investigations on the ignition and explosion of gaseous mixtures, in which principles of fundamental importance were established. His thermo-electric couple inaugurated a new period in the measurement of high temperatures. One of the pioneers of micro-metallurgy, he was among the first to introduce exact methods into the science of industrial silicates. Prof. le Chatelier was elected a foreign member of the Royal Society in 1913, and allotted the distinction of its Davy medal in 1916, in respect of his eminence as a chemist.

Sir RICHARD GARTON was educated at Owens College, Manchester, and the University of Marburg. As honorary secretary of the British Empire Cancer Campaign he has carried out work of widespread importance.

Prof. MAX VON LAUE, Nobel laureate, 1915, was born at Pfaffendorf, near Coblentz. His studies were conducted at the Universities of Strasbourg, Munich and Berlin. In 1912 he occupied a chair in the University of Zurich, and was afterwards at Frankfort. Since 1919 he has been professor of theoretical physics in the University of Berlin. Prof. Max von Laue was allotted the Nobel prize in physics for 1915, for his discovery of the diffraction of Rontgen rays in crystals.

Prof. SEWARD, Master of Downing College, Cambridge, professor of botany in and vice-chancellor of the University, was educated at Lancaster Grammar School and St. John's College, Cambridge. The Royal Society awarded Prof. Seward a Royal Medal last year for his fruitful studies in palæobotany, which have proved of direct stratigraphical value to geologists, enabling the principles and facts of one science to aid, and even solve, the problems of another.

Societies and Academies.

PARIS.

Academy of Sciences, August 30.—Bigourdan: The regularity of the diurnal movement and the possibility of verifying it by means of observatory clocks (see also NATURE, September 18, p. 425).—Boris **Delaunay**: The theory of parallelohedra.—G. **Polya**: The linear functional operations exchangeable with the derivation and the zeros of the sums of exponentials.—Mlle. N. **Bary**: The analytical representation of a class of continuous functions.—A. **Kovanko**: The integration of suites of functions capable of summation.—Kyrille **Popoff**: The convergence of series and celestial mechanics.—**Krawtchouk**: The method of N. Kriloff for the approximate integration of the equations of mathematical physics.—N. **Bogoliouboff** and N. **Kriloff**: The justification of Rayleigh's principle by the order of the error committed at the nth approximation.—Jacques **Bourcart**: An attempt at the morphological interpretation of the Bouches de Cattaro.—Lucien **Daniel**: Researches on the grafting of garlic and cabbage.—Antonin **Němec**: Chemical methods for determining if agricultural soils are in need of nitrogenous or potash manures. Details of the analytical methods and limits of nitrate and potash suitable for sugar beet, barley, and oats.—Raymond **Hamet**: The inversion of the normal action of adrenaline.—E. **Ducloux** and Mlle. G. **Cordier**: The virus of sheep scab treated with various aldehydes.

CAPE TOWN.

Royal Society of South Africa, August 18.—L. P. **Bosman**: The nature of the co-enzyme of lipase. The lipase extract (from sheep's pancreas) is dialysed against distilled water and the lipolytic actions of the dialysate and the 'inside' liquid on ethyl butyrate are studied. The inside liquid loses approximately 50 per cent. of its hydrolytic power. The dialysate, while having no hydrolytic power, when coupled with the inside liquid, restores the lipolytic power of the original extract. The dialysate was investigated and the so-called co-enzyme was found to be inorganic salts.—W. **Rose** and J. **Hewitt**: Description of a new species of Xenopus from the Cape Flats. The new species, *Xenopus gilli*, differs from *X. laevis* in that tentacles are not apparent and that there is in the mouth an organ which is either a posteriorly attached tongue or a deflated air-sac.—J. H. **Power**: Notes on the habits and life histories of South African Anura with descriptions of the tadpoles.—C. von **Bonde**: The vascular system of the Plagiostomi, with special reference to the common dogfish (*Squalus acutipinnis*, Regan). The author has previously worked out the morphology of the vascular system of the South African dogfish *S. acutipinnis* and it is now compared with the structure typical of the Plagiostomi in general. The absence of vascular loops round the gill-arches together with the absence of a precardiac extension of the dorsal aorta presents an interesting feature. The arterial circulation of the cephalic region also shows a distinctive difference from the normal distribution of the carotid arteries in the Plagiostomi.—Neville S. **Pillans**: The African genera and species of Restionaceae.—H. G. **Fourcade**: A new method of aerial surveying.

ROME.

Royal National Academy of the Lincei: Communications received during the holidays.—T. **Levi-Civita**: Einsteinian motions in second approximation.—Ferruccio **Zambonini** and S. **Restaino**: Double sulphates of the rare earth and alkali metals (vi.). Cerous

potassium sulphates. In addition to the double salts already described, this system forms the compound, $Ce_2(SO_4)_3$, 4·5 K_2SO_4, which is stable in the presence of solutions containing from about 5 per cent. to 1·2 per cent. of potassium sulphate.—G. **Bruni** and A. **Ferrari**: Crystalline structure of certain bivalent chlorides. Anhydrous magnesium, manganous and cadmium chlorides are found to be of rhombohedric structure with the respective axial ratios, 2·45, 2·34, and 2·20. Zinc chloride appears to exhibit a rhombohedric or hexagonal structure, the dimensions of its structure indicating its structural similarity to magnesium chloride.—Silvio **Minetti**: Investigation of the singularity of $f(z)=\sum_{n=0}^{n=\infty} a_n z^n$, where $a_n=g(n)$ for n a positive integer with $g(n)$ wholly transcendental.—Mauro **Picone**: The isolated singularity of harmonic functions in two or more variables.—Oscar **Zariski**: Conformable representation of the area bounded by a lemniscate on a circle.—Luigi **Fantappié**: The polydromy of linear analytic functionals.—A. M. **Bedarida**: A new rectilinear congruency.—Harry **Levy**: Einsteinian motions of a disgregate medium with spherical symmetry.—Arnaldo **Belluigi**: Evaluation of the damping in seismographic pendulums.—Rita **Brunetti**: Theory of the polarisation of independent X-rays.—G. **Natta** and A. **Reina**: Oxides and hydroxides of cobalt: Crystalline structure of cobaltous oxide and hydroxide. The results of X-ray analysis show that cobaltous oxide belongs crystallographically to the monometric system and has an elementary cell of side a 4·22 Å.U. of the sodium chloride type, containing four molecules. The precipitated and crystalline forms of cobaltous hydroxides are structurally identical and are of the uniaxial rhombohedric type.—Raoul **Poggi** and Angiolo **Polverini**: Destruction of filter-paper by alternate oxidising agents applied to quantitative analysis.—Adolfo **Quilico**: Röntgenographic investigation of metallic hydrides: copper hydrides. The so-called hydrides obtained by reducing cupric oxide by means of hydrogen prove to be either pure copper or copper containing occluded hydrogen in proportion insufficient to modify appreciably the crystal lattice. The products formed in the reaction between hypophosphorous acid and copper sulphate vary with the temperature employed and consist either of amorphous copper containing occluded hydrogen or of a mixture of this with cuprous oxide.—C. **Sandonnini**: Heats of mixing of water with acetic acid and with isopropyl alcohol.—Emanuale **Quercigh**: The nature of stibiobismuthinite. This mineral, found in Nacozari, Mexico, consists of an isomorphous mixture of bismuthinite and antimonite, with or without inclusions of sulphur.—C. **Acqua**: The virus of the polyhedry of the silkworm in relation to modern theories on the filterable virus.

Official Publications Received.

Canada. Department of Mines: Geological Survey. Memoir 148, No. 129 Geological Series: Geology and Mineral Deposits of Windermere Map-area, British Columbia. By J. F. Walker. (No. 2088.) Pp. 69. 20 cents. Summary Report, 1924, Part C. (No. 2091.) Pp. 268C. (Ottawa: F. A. Acland.)

Education Committee for the County Borough of Brighton. Technical College, Richmond Terrace, Brighton. Day Courses, Session 1926–27. Pp. 79+9 plates. Evening Courses, Session 1926–27. Pp. 48. (Brighton.)

Almanach České Akademie věd a umění. Ročnik 35. Pp. 240. (Praze.)

Académie Tchèque des Sciences (Česká Akademie věd a umění). Bulletin International: Résumés des travaux présentés. Classe des sciences mathématiques, naturelles et de la médecine. 23e année (1923). Pp. 5+266. 25e année (1925). Pp. iv+385. (Prague.)

Premier Congrès International pour la Protection de la Nature, Faune et Flore, Sites et Monuments Naturels (Paris, 31 mai-2 juin, 1923). Rapports, Vœux, Réalisations. Pp. viii+388. (Paris: Paul Lechevalier.

Instituts scientifiques de Buitenzorg: "'sLands Plantentuin." Treubia: Recueil de travaux zoologiques, hydrobiologiques et océanographiques. Vol. 6, Supplément, Avril 1926: The Bloodsucking Arthropods of the Dutch East Indian Archipelago. vii: The Tabanids of the Dutch East Indian Archipelago (including those of some neighbouring Countries) By Dr. J. H. Schuurmans Stekhoven, Jr. Pp. 551+18 plates. Vol. 8, Supplément, Juillet: Die Jugendstadien der malayischen Thysanopteren. Von H. Priesner. Pp. iii+264+16 Tafeln. (Buitenzorg: Archipel Drukkerij.)

Ceylon Administration Reports for 1925. Part 4: Education, Science and Art (D). Administration Report of the Director of Agriculture for 1925. Pp. D60. (Colombo: Government Record Office.) 1.25 rupees.

Bureau of Education, India. Education in India in 1924–25. Pp. iii+59. (Calcutta: Government of India Central Publication Branch.) 1.6 rupees; 2s.

Memoirs of the Department of Agriculture in India. Entomological Series, Vol. 9, No. 5: Experiments on the Transmission of Rinderpest by Means of Insects. By S. K. Sen. Pp. ii+59-185. (Calcutta: Government of India Central Publication Branch.) 2.4 rupees; 4s. 2d.

The Hundred and Fourth Report of the Commissioners of Crown Lands, dated 20th June 1926. Pp. 36. (London: H.M. Stationery Office.) 4s. net.

The Indian Zoological Memoirs on Indian Animal Types. 1: Pheretima (The Common Indian Earthworm). By Prof. Karm Narayan Bahl. Pp. v+72. (Lucknow: The University.) 1.8 rupees.

Cambridge Observatory. Annual Report of the Observatory Syndicate, 1925 May 19-1926 May 18. Pp. 8. (Cambridge.)

The Journal of the American Chemical Society. Vol. 48, No. 8-a; Golden Jubilee Number, August 20, 1926: A Half-Century of Chemistry in America, 1876-1926; an Historical Review commemorating the Fiftieth Anniversary of the American Chemical Society. Edited by Charles A. Browne. Pp. xiv+254. (Easton, Pa.: American Chemical Society.)

South African Sugar Association. Proceedings of the Fourth Annual Congress held at Durban on April 12th to 16th, 1926. Pp. 109. (Durban: South African Sugar Association.)

Union of South Africa: Department of Agriculture. Science Bulletin No. 48 (Division of Chemistry Series No. 66): Fumigation with Hydrocyanic Acid Gas; Concentration and Distribution as influenced by Fumigation Procedure. By B. J. Smit and Dr. T. J. Naude. Pp. 28. Science Bulletin No. 49: Experiments in Veld Management, First Report. By R. R. Staples. Pp. 35. (Pretoria: Government Printing and Stationery Office.) 3d. each.

Geofysiske Publikasjoner utgitt av det Norske Videnskaps-Akademi i Oslo. Vol. 4, No. 7: Résultats des mesures photogrammétriques des Aurores boréales observées dans la Norvège méridionale de 1911 à 1922. Par Carl Størmer. Pp. 108+48 planches. (Oslo: A. W. Broggers Boktrykkeri A/S.) 12 kr.

D. Kgl. Danske Vidensk. Selsk. Skrifter, naturvidensk. og mathem. Afd., 8 Række, 11, 1: La surface de la planete Jupiter 1919–1924. Par C. Luplau Janssen. Pp. 88+7 planches. (København: Andr. Fred. Høst and Søn.) 10 kr.

The East London College (University of London). Calendar, Session 1926–1927. Pp. 184. (London: East London College.)

Ministry of Agriculture and Fisheries: Standing Committee on River Pollution. River Pollution and Fisheries: a Non-Technical Report on the Work during 1925 of the Standing Committee on River Pollution appointed in 1921. Pp. 33. (London: H.M. Stationery Office.) 6d. net.

The British Mycological Society. Transactions, Vol. 11, Parts 1 and 2, August 26th. Edited by Carleton Rea and J. Ramsbottom. Pp. 168+6 plates. (London. Cambridge University Press.) 15s. net.

University of London, University College: Faculty of Medical Sciences. University Centre for Preliminary and Intermediate Medical Studies. Courses for Dental Students, Session 1926–1927. Pp. vi+227-262+10. (London: University College.)

Journal of the Marine Biological Association of the United Kingdom. New Series, Vol. 14, No. 2, August. Pp. 289-555. (Plymouth: Marine Biological Association.) 10s. net.

Conseil Permanent International pour l'Exploration de la Mer. Bulletin hydrographique pour l'année 1925. Pp. 49. Bulletin hydrographique: Appendice supplémentaire d'observations de surface anglaises pour la periode 1915–1923. Pp. 64. Bulletin hydrographique: Appendice 1 et 2 pour les années 1923 et 1924. Pp. 20. Rapports et procès-verbaux des réunions, Vol. 40. Rapport Atlantique 1925 (Travaux du Comite du Plateau continental Atlantique) (Atlantic Slope Committee). Pp. 60. (Copenhague: Andr. Fred. Høst et fils.)

Transactions of the Royal Society of Canada. Third Series, Vol. 20, Section 4. On some Minerals from the Ruby Mining District of Mogok, Upper Burma. By Frank D. Adams and R. P. D. Graham. Pp. 113-136. (Ottawa: Royal Society of Canada.)

Aeronautical Research Committee: Reports and Memoranda. No. 1104 (Ae. 211): Further Experiments on the Relation between Skin Friction and Heat Transmission. By Miss Dorothy Marshall. Work performed for the Engineering Research Board of the Department of Scientific and Industrial Research. (D.1. Special Technical Questions, 132.–T. 2082.) Pp. 19+12 plates. 1s. net. No. 1012 (M. 35): Some Comparative Fatigue Tests in special relation to the Impressed Conditions of Test. By H. J. Gough and H. J. Tapsell. Work performed for the Engineering Board of the Department of Scientific and Industrial Research (M C. 79, 157, 167, 167A.) Pp. 21. 1s. net. No. 1021 (E. 19): The Effect of Metallic Sols in delaying Detonation in Internal Combustion Engines. By Ft.-Lieut. C. J. Sims, assisted by Dr. E. W. J. Mardles. (I.C.E. 516.) Pp. 11. 6d. net. No. 1013 (E. 18): Report on Dopes and Detonation. By Prof. H. L. Callendar, assisted by Capt. R. O. King and Flying Officer C. J. Sims. (B. 4. Engines 55.—T. 2151, I.C.E. 508.) Pp. 54+13 plates. 2s. net. No. 1022 (M. 38): An Experiment to determine if Slip can be detected during the Unloading Portion of a Cycle of repeated Tensile Stresses. By H. J. Gough, S. J. Wright and Dr. D. Hanson. Work performed for the Engineering Research Board of the Department of Scientific and Industrial Research. (B. 1.a. Metals, 46.—T. 2165.) Pp. 6+3 plates. 6d. net. (London: H.M. Stationery Office.)

Government of India: Department of Industries and Labour, Public Works Branch. Irrigation in India: Review for 1924-25. Pp. 37. (Simla: Government of India Press.)

of historical materialism pure and simple. Here again we have a restatement of a point of view so much repeated and debated that it has grown stale for the sociologist. Yet the author, judging from his quotations, is unaware of the existence of Marx, Loria, H. Cunow, and of such of their opponents as Benedetto Croce, Schmoller, and others.

Against the charges of social Darwinism and extreme Marxism the author might shelter himself behind a number of chapters in which he extols altruism and righteousness, parental love and filial piety, the obedience to law and general good temper. Mr. Machin does not even forget the amenities of life, sports and amusements, music-halls and moving pictures, which all form the virtues of the evolutionary metaphysician. Only to religion does he remain decidedly unfriendly and unfair. "The office of civil government, and more particularly of religion, is then essentially negative. . . . Progress, the advancement of individual and national prosperity is not due to religion" (p. 246). Many similar unfriendly sentiments might be adduced from Mr. Machin's chapter on law and religion.

These many virtues and ethical commandments of evolutionism—such as military truculence, Rotarian graspingness, parental love, righteousness, and love of amusement—are, however, not welded into any consistent scheme. At best it is made plausible that they are not inconsistent with the loosely conceived Darwinism. This might be considered satisfactory if we agreed with the author to regard Darwinism as a form of religion. Regarded as a mere scientific method or system of thought, Darwinism, or the theory of natural selection, cannot yield such a multitude of virtues.

Here we come to the really important question concerning the book. Apart from its metaphysical claims —with which it is quite impossible to come to any understanding—the book has a serious and methodologically interesting aim. One of its purposes is to apply the principle of natural selection to the development of culture and to illuminate several aspects of human civilisation in this manner.

To the average sociologist the promise of applying Darwinism to the study of culture sounds as would to the physicist another device for circumventing the first law of thermodynamics by a new plan for establishing perpetual motion. Natural selection, in the sense in which it is used by biologists, does not act on individuals of the human species, because culture stands between man and the selective action of Nature. In the very process of procreation man shows a radical difference as compared with the animal, in that he can and does control fertility and is able to protect the offspring beyond any limits which animals can reach. Mr. Machin, in fact, has seen this point and treated it more fully and intelligently in several of his chapters than most sociologists and anthropologists have done. Beyond parental care, 'mutual aid' is, as Kropotkin has shown, the rule in humanity rather than the 'struggle for existence.' The human individual, again, does not merely rely on anatomical endowment—he has the whole of material culture at his disposal. He is not adapted to his environment merely by his physiological processes and instincts—he has developed knowledge, belief, and tradition. In brief, the animal under conditions of Nature, and man under conditions of culture, show different forms of mating, of co-operation, of practical dealing with environment, in short, of adaptation. Cultural process is not identical with natural evolution, and biological principles cannot be directly applied to the study of man. This is the reason why even such brilliant attempts as those of Bagehot, of Gumplowicz, or of Enrico Ferri have not led very far, and anthropology from Bastian and Tylor up to Frazer and Westermarck has not attempted to apply natural selection to the comparative study of human society. There is, in fact, a considerable methodological literature on the subject of the delimitation between natural and cultural science to mention only such names as Dilthey, Paul Barth, H. Rickert—and the new attack of the so-called historical school against anthropological evolutionism has justifiably pointed out the dangers of borrowing a method, a terminology, and a conceptual apparatus by one science from another.

Of all this Mr. Machin is apparently unaware. His anthropological quotations do not reach very far beyond Herbert Spencer, who is decidedly not sufficient as a source book and intellectual arsenal of anthropology and sociology. Of this it is impossible to make a valid charge against the present book, for Mr. Machin frankly calls himself a layman in the preface and admits that "this essay is based, in the main, on the works of the two giants of evolution theory Darwin and Spencer." Nor is it possible to contradict him on this point, for the present book contains no original research, no addition to method, and no really new principles. Perhaps the one exception to this is the discussion of the difference between the regulation of animal and human fertility in the second section of the book. This discussion, however, has no direct bearing on the main anthropological part of his contribution.

There is one aspect, however, under which this book is of considerable importance in spite of its serious shortcomings; and that is the reason why it has been necessary to criticise it more fully instead of damning it with faint praise. Although any attempt to apply

the principle of natural selection to the evolution of human culture must, in the opinion of the reviewer, prove unsuccessful, such an attempt raises once more the capital problem of anthropology. Mr. Machin's book reminds us again that man has evolved from lower animal species and that this cannot be denied by any one except the crazy fundamentalist. Human culture again, has evolved from the state of Nature, from a zero level, so to speak. Both these facts bring up the problem: What is the action of natural conditions upon man? What is the difference between human relations to the environment and animal adjustment, what is the difference, in short, between evolution in biology and evolution in culture? The anthropologist of to-day is satisfied with pointing out, negatively, that the cultural process differs from the biological one. This is sufficient reason not to mix them up, but it is not a sufficient reason not to compare them. Only comparison can bring out the essential similarities as well as the differences in either process. Most modern anthropologists of the so-called historical school have been busy pooh-poohing the concept of human evolution and the study of the origins of institutions and the causes of progress.

All these questions are constantly raised by the argument of the book reviewed. Some of the arguments may have to be rejected, but they will have to be replaced, for Mr. Machin has the great gift of seeing the problem and formulating it clearly--a gift of more value in science than the facility to solve irrelevant and imaginary questions. The author is handicapped by his out-of-date reading, by his adhesion to his authorities, and by a lack of first-hand acquaintance with his material. But in honesty of thought, lucidity of exposition, and clarity of style the book is often excellent, and through these virtues it is especially fitted to suggest the real problems to the anthropologist. It is a work which no student of man should omit to read. Science does not thrive by mere avoidance of errors, but by resolute grappling with real problems. From this point of view Mr. Machin's book is a more valuable contribution to anthropology than many modern works which startle us with revelations about the 'diffusion' of culture from Egypt, Atlantis, Yucatan, or some other Garden of Eden. Anthropology will become a useful science only after it has realised once more that the problems of evolution of culture cannot be shirked any more than the problems of evolution of species. If Mr. Machin's book helps in combating anthropological fundamentalism—the bitter opposition to evolutionary thought within the science of man—it will have fulfilled its mission, even though we must reject it as the "new Gospel."

B. MALINOWSKI.

Aids for the Spectroscopist.

(1) *Tabelle der Hauptlinien der Linienspektra aller Elemente nach Wellenlänge geordnet.* Von Prof. H. Kayser. Pp. vii + 198. (Berlin: Julius Springer, 1926.) 24 gold marks.

(2) *Atlas de spectres d'arc: tableaux d'analyse pour les recherches spectrochimiques.* Par Dr. Jacques Bardet. Pp. 55 + 54 planches. (Paris: Gaston Doin et Cie, 1926.) 240 francs.

ONE of the outstanding features of recent progress in experimental physics is the remarkable development of research in spectroscopy. This is largely due to the efforts of theoretical workers who, although the precise physical meaning of their assumptions cannot always be assigned, have nevertheless achieved amazing success in constructing semi-empirical rules for the analysis of spectra. The generality and extremely suggestive character of these rules have inspired fresh investigations of the spectra of the majority of the elements, with the result, among others, that lists of spectrum lines which were once regarded as complete are being augmented to a surprising extent and at an unprecedented rate.

Such an accumulation of data, provided they be accurate, is an unqualified blessing, but its attainment is not unattended by considerable danger. Rapidity of progress does not always allow the application of the rigid and impartial criticism of every detail of the experiment which alone can ensure freedom from error. If, for example, a group of, say, seven lines is predicted in a spectrum, and the experimenter who has already obtained six of them ultimately finds the seventh, and weakest, on a well-exposed plate, the new line runs some risk of missing the stringent test for impurities which is its due. On the other hand, if an unexpected line, or one of uncertain behaviour, appears in a spectrum, it may be rejected as a possible impurity on the 'safety first' principle (a principle, by the way, which in practice often means 'safety only'), and the existence of an important line thereby lost sight of. We have known of recent examples of these and other sacrifices to the ideal of early publication which, in the long run, delay rather than advance progress.

(1) In order to minimise such dangers as these, Prof. Kayser, to whom spectroscopy already owes so much, has placed the scientific world under yet another debt of gratitude by the preparation of the first of the books before us. The table of 'Hauptlinien' at the end of volume 6 of his monumental 'Handbuch der Spektroscopie" (1913) has long been familiar to every spectroscopist, and in the new volume he has adopted the same general method of presentation as was employed therein. The progress of the last thirteen

years, however, has made some changes of detail necessary. The wave-lengths are now given only in international angstroms, Rowland's scale having become obsolescent. The values recorded are the weighted means of all the observations available, and are given only to such a degree of accuracy as the compiler considers trustworthy. The limits of wave-length included have been extended at both ends of the scale, and the table includes fainter lines than the earlier list, so that the total number of lines (now about 19,000) is almost doubled. In the Schumann region, owing to the fact that, of necessity, only the stronger lines are at present observable, all the recorded lines are included. Another modification of the original table is the indication of the degree of ionisation (where it is known) of the element to which a line belongs. Thus, λ 5889·965 is no longer recorded as Na, but as NaI. About 15 per cent. of the stronger lines can at present be so classified.

It is needless to point out the value of such a book as this, or to comment on the excellent manner of its production. It is obviously indispensable to every experimental spectroscopist.

(2) The atlas of M. Bardet is designed to encourage and facilitate the use of spectrum analysis by chemists. It comprises 48 principal plates and a few supplementary ones intended to illustrate special features of the process. Each plate of the main set shows the prismatic spectrum of iron as seen in the microscope, with an adjacent scale of angstroms. Above this spectrum vertical lines are drawn at the positions occupied by the lines of the various elements (the chemical symbol, approximate wave-length and intensity being placed against each line for identification), and it is intended that the experimenter, having photographed the spectrum of the material to be examined in contact with that of iron, shall compare his negative with the atlas and so identify the unknown lines. The 48 plates are divided into six series, in each of which the iron spectrum over the range λ 3500-λ 2500 is shown in 8 plates. In the first series the adjacent lines include all the lines of the elements with fairly simple spectra, and the most characteristic lines of the remaining elements, as they appear in the spectrum of the arc. The remaining series show, in greater completeness, the positions of the lines of the more complicated spectra, each series being devoted to a particular group of elements. In this way overcrowding of lines is satisfactorily avoided.

The iron spectra, though originally drawn by hand, are faithfully copied, and simulate the appearance of photographs remarkably well. The wave-lengths are taken from the tables of Exner and Haschek, and are given in terms of Rowland's scale. The method of using the atlas (in which full use is made of the *raies ultimes* of de Gramont), together with instructions relating to the whole process of spectrum analysis, is given in detail in an accompanying brochure, which contains also a preface by M. Urbain in which the neglect of spectrum analysis by chemists is discussed and deplored.

Both in design and in execution the work is excellent, and the accompanying notes testify to the wide experience of the author in this branch of study. The production should prove of great value not only to chemists but also to all who have occasion to use spectrum analysis. The author is to be congratulated on meeting an obvious need so effectively, and it may be confidently predicted that his work will be widely used. When, however, M. Urbain, in the preface, claims that M. Bardet " est probablement le seul homme au monde qui, d'un rapide coup d'œil jeté sur un spectre, puisse énumérer immédiatement les principaux corps qui l'ont produit," he is presumably thinking only of chemists. There are spectroscopists of much longer experience than M. Bardet who acquired this faculty many years ago. H. D.

Rubber: Natural or Synthetic?

Synthetic Rubber. By Dr. S. P. Schotz. Pp. 144. (London: Ernest Benn, Ltd., 1926.) 21s. net.

THE meaning of the title of this book, although sufficiently clear to satisfy the general public, is, from a scientific point of view, entirely unsatisfactory. The author evidently feels this when in the first few lines he writes:

"Even samples of natural rubber probably differ widely in details of constitution. To attempt to reproduce a synthetic rubber of exactly the same constitution as a specific natural rubber would be difficult and futile. Fortunately it is possible by synthetic means to obtain substances which are constituted similarly to natural caoutchouc as far as the linking of the various hydrocarbon groupings is concerned, having similar physical properties and offering the same resistance to chemical reagents and mechanical influences. The whole development of this coming industry is tending in that direction."

It is therefore clear that the word 'rubber' is applied to a number of substances or, rather, mixtures of substances which possess certain physical properties in common which are more or less standardised.

Natural vegetable products are rarely found in a chemically pure state: if the substance is a solid of relatively low molecular weight, it is usually capable of being obtained in a state of purity by some method of crystallisation. If the vegetable product is a liquid, it can frequently, but not always, be purified by

fractional distillation either under ordinary conditions or under reduced pressure. When the substance is a colloid of high and unknown molecular weight, the above-mentioned methods of purification are not available. It is true that, in the case of most natural caoutchoucs, the greater part, if not all, of the comparatively small amount of 'impurities' it contains can be removed by selective solvents, leaving a residue of presumably pure matter which on analysis gives figures corresponding to the general formula $(C_5H_8)_n$. On subjecting this matter, or the unpurified caoutchouc, to destructive distillation, various hydrocarbons are produced mostly possessing the same percentage composition, but of lower molecular weights than the original substance, and amongst them the key substance to the synthesis of caoutchouc is found. This is the simple hydrocarbon, isoprene, C_5H_8, boiling at about 33°-34° C.

Isoprene was first obtained by Himly in the year 1835 by the destructive distillation of rubber, and was later examined by a number of chemists, but its structure was first determined by Sir William Tilden as being β-methyl butadiene:

$$\begin{array}{c}CH_2=\underset{\displaystyle CH_3}{\underset{|}{C}}-\underset{\displaystyle H}{\underset{|}{C}}=CH_2\end{array}$$

Tilden obtained isoprene by the destructive distillation of both caoutchouc and turpentine, and satisfied himself that the light hydrocarbons obtained from both sources were identical. He further found that, on keeping for a short time, the very mobile isoprene became viscid and, after a period of some years, produced a white solid which had most of the properties of india-rubber. He also examined the catalytic action of a large number of substances on isoprene and came to the conclusion that isoprene was the parent substance of caoutchouc. Other chemists afterwards worked upon the production of isoprene, but almost entirely from a scientific point of view, and the possibility of a commercial synthesis of rubber was not seriously considered until about 1910, when the shortage of rubber and its rise in price to about 10*s*. per pound caused a large amount of work to be undertaken to see whether rubber could be produced commercially.

The problem was attacked seriously both in Great Britain and in Germany. Messrs. Strange and Graham organised a group of research workers in the former, and in the latter the like work was undertaken by the Farbenfabriken vorm. F. Beyer and, to a lesser extent, by the Badische Anilin- u. Soda-Fabrik.

At first the work in both countries consisted chiefly in exploring any possible routes by which isoprene could be produced cheaply. The most obvious method, namely, the cracking of turpentine, was soon abandoned, as the yield of isoprene was too small to be remunerative. Of organic compounds containing 5 atoms of carbon, the most promising seemed to be normal pentane, isopentane, and isoamyl alcohol, occurring in fusel oil.

Normal pentane itself is not, theoretically, a good starting-point, as it contains a straight chain of 5 carbon atoms and, unless isomerisation took place during the series of reactions, only an isomer of isoprene could be obtained. The isopentane route was also explored, but was not persevered with owing to the difficulty of obtaining the raw material in sufficient quantity at that time. Isoamyl alcohol was found to be a good raw material, but it could not be obtained either in sufficient amount or at a suitable price.

The English workers then attempted to get increased quantities of isoamyl alcohol by a fermentation process and, with the help of Prof. Fernbach of the Pasteur Institute, a bacterium was isolated which, acting upon starchy material, produced not isoamyl alcohol but normal butyl alcohol and acetone in a yield of nearly 50 per cent. of the starch taken. Meanwhile the German chemists seem to have reached more or less the same conclusion as their English rivals.

It was known by this time that hydrocarbons possessing the conjugated double linking

$$\diagdown C=C-C=C\langle$$

were capable of being polymerised into rubber-like substances. As substances of this type containing 5 carbon atoms were not easily obtainable, the German work concentrated upon members of this group containing 4 and 6 atoms of carbon. The 4-carbon substance, C_4H_6, known as butadiene, divinyl, or erythrene, was obtainable in various ways, but no completely satisfactory raw material was obtainable and the Fernbach bacillus was not available to them. They therefore concentrated chiefly upon the 6-carbon member β-γ-dimethyl butadiene or di-isopropenyl. This substance could be obtained fairly readily from acetone, which was reduced to pinacone, from which di-isopropenyl was obtained without difficulty.

The English group, now having plentiful supplies of *n*-butyl alcohol, worked almost exclusively upon the best method of converting this substance into butadiene, which was by now known to polymerise into a substance having similar properties to the polymer produced from isoprene. The raw materials and methods of producing the hydrocarbons C_4H_6 and C_6H_{10} having been provisionally settled, work now concentrated upon methods of polymerising these into rubber-like substances. Here both groups, almost simultaneously, hit upon the same method, namely, by means of metallic sodium,

but the English group, owing to a priority of a few days in the date of the patent specification, succeeded in upholding their patent rights both in Great Britain and in Germany.

It appeared afterwards from the work of Harries on the ozonides of rubbers that so-called sodium rubbers were not identical with the rubbers obtained by simple heat polymerisation. They had, however, remarkably good properties as regards elasticity, etc., and Harries in a paper in the *Annalen* looked upon sodium butadiene rubber as being the best synthetic rubber produced. These rubbers were capable of being vulcanised like natural rubber, which improved their properties considerably, but the 6-carbon rubber, although made on a considerable scale in Germany during the War, did not possess the elasticity of its lower C_4 homologue and was very prone to undergo destruction by oxidation in air. On the other hand, a sample of sodium butadiene rubber recently examined after keeping for a period of thirteen to fourteen years was found to possess its original properties practically unimpaired.

The important question arises: Will synthetic rubber ever supplant the natural substance? This in the opinion of the writer of the present article is entirely a matter of price. Rubber can be produced on well-managed estates at about 8*d.* per pound. At the present artificial price of 1*s.* 8*d.* per pound synthetic rubber is bound to come shortly, and the probable source will be American petroleum.

Reverting to Dr. Schotz's book: it gives a clear and not too technical account of the art of making synthetic rubber as known to-day. It is fairly free from mistakes, but some have been noticed. On p. 58 bauxite is classed as a hydrated iron compound. On p. 64 1 : 3 dimethyl butadiene should be 2 : 3. The book is somewhat marred by the introduction of plates, dealing with machinery for rubber manufacture, which have no connexion with the subject matter. On the whole, a very readable and interesting account is given of a very technical subject.

Our Bookshelf

British Museum (Natural History). Catalogue of the Machæridia (Turrilepas and its Allies) in the Department of Geology. By T. H. Withers. Pp. xv + 99 + 8 plates. (London: British Museum (Natural History), 1926.) 7*s.* 6*d.*

ON account of their sabre- or blade-shaped form, the name Machæridia is proposed for the group of Palæozoic fossils which comprises the genera Lepidocoleus, Turrilepas, Deltacoleus, and Plumulites. These genera are undoubtedly related to one another, but their systematic position has long been a matter of dispute. Although regarded by some authors as Mollusca (Polyplacophora), Cystidea, Annelida, or Trilobita, they have usually been referred to the Cirripedia; and several writers have looked on them as the ancestors of the stalked barnacles of later times. This view, which is based largely on a comparison with the Chalk form Stramentum (Loricula), is shown by Withers to be untenable, since that genus is now known to be an aberrant type representing a specialised side-line of development from the scalpelliform barnacles, and further, none of the Palæozoic genera can be proved to be Cirripedia, the earliest undoubted representative of that group being found in the Rhætic beds.

In the Machæridia the shell apparently covered the whole of the soft parts of the animal; it consists of either two or four columns of plates and could open along the whole of the sharp edge, and the plates along the thick margin show muscle-scars indicating the presence of a series of transverse muscles. The fact that the plates in some genera consist of crystalline calcite and show a reticulate structure suggests relationship with the Echinoderma, while the imbrication of the plates and the character of their ornamentation may indicate a connexion with the Cystidea. In his preface to the volume, Dr. F. A. Bather shows that he is inclined to accept this view of the affinities of the Machæridia, and suggests that the Heterostelea and Machæridia are among the earliest offshoots of the echinoderm stem and differ from all other classes of echinoderms in not having had pentamerism and the other echinoderm features impressed on them during an ancestral period of fixation.

Although bearing the modest title of "Catalogue," this work is really of the nature of a monograph and deals in a thorough manner with all the species known. The eight plates are excellently reproduced in collotype from photographs by H. G. Herring.

The Wonder and the Glory of the Stars. By Dr. George Forbes. Pp. 221 + 16 plates. (London: Ernest Benn, Ltd., 1926.) 8*s.* 6*d.* net.

WE have much enjoyed reading Prof. Forbes's book, which consists largely of a selection of his numerous lectures delivered during the last twenty-two years and of related essays. The title is a true indication of the author's wish to convey something of his own enthusiasm for the wonders of the night sky accessible to all who care to look for them. Prof. Forbes has long been associated with astronomy, and he has watched its widening horizon from the early days of stellar spectroscopy and astronomical photography. A personal touch is conveyed to the reader by occasional reminiscences of men and events, including an account of a night spent by the author in 1871 at the Vatican Observatory with Secchi and his spectroscope, and impressions of meetings of the Royal Astronomical Society in 1926 which enter into the theme of the last chapter entitled "Fairy Tales by Astronomers."

As already indicated, the book lays no claim to being an elementary text-book of astronomy, but comprises a series of self-contained, yet interdependent articles, the popular nature of which is fully indicated by most of the titles—" Surprise Visitors among the

Stars," "Tornadoes in the Sun," "Stars and their Wireless Messages," etc. By this method of treatment, the reader who scans the pages from cover to cover in an evening or two must necessarily encounter some unavoidable repetition of salient facts. On the other hand, a few points of general interest have been omitted. No mention is made, for example, of the *cyclical* change of the shape of the sun's corona. The description of Cepheid variables might well have contained a few sentences concerning their use in the determination of stellar distances. Again, in the chapter on "Greenwich Observatory" a brief reference is due to the instrument which produced the original of Plate VI., as being typical of another branch of routine work carried on for more than fifty years. It may be added that the type is scarcely large enough for a popular work. There are very few misprints, but the index is defective in a few places. The illustrations are a pleasing feature and include several of the most recent astronomical photographs, the reproduction of which is above the average standard for books of this kind.

A Manual of Elementary Zoology. By Dr. L. A. Borradaile. (Oxford Medical Publications.) Fifth edition. Pp. xvi + 670 + 16 plates. (London: Oxford University Press, 1926.) 16*s.* net.

DR. BORRADAILE'S "Manual" is well known to all teachers of zoology, and, to judge from the frequency with which new editions appear, it must also be well appreciated by students. In these circumstances praise is superfluous and interest centres on the changes which the new edition shows. The most important of these are in the accounts of the movement of Amœba and of the relation of individuality to metabolic gradient, while the introductory chapter, the chapter on reproduction and sex, and that on the animal in the world, have been rewritten—and much improved.

A good deal of new matter has crept into the book since its first appearance, with the inevitable result that the medical student meets in it much that does not concern him, while the pure zoologist finds some rather serious omissions and some cases of too extreme condensation. There is no mention, for example, of Helix, Peripatus, or Ciona, and the reviewer's experience of the chapters on evolution and embryology is that they are too compressed to be of great value to the student. No two authors, however, would solve the problem of what to omit in the same way. On the whole, Dr. Borradaile's choice is a wise one; he maintains a balance between morphology and philosophy which makes his book a scholarly treatise, and one that can be unreservedly recommended.

Elements of Photogravure, Photo Printing from Copper Plates: Screen Photogravure simply explained, with full Working Instructions and an Explanatory Chapter on Modern Rotary Gravure Printing. By Colin N. Bennett. (Lockwood's Manuals.) Pp. viii + 129. (London: Crosby Lockwood and Son, 1926.) 5*s.* net.

MR. BENNETT describes in clear and simple language every step of the process of the making of photogravure prints by the screen plate process, leaving the original dust-grain process with little more than a bare mention as out-of-date. He begins with the getting of the necessary apparatus and materials, and estimates the prime cost to one who has the usual photographic necessities at from 10*l.* to 15*l.* This includes a copperplate printing press. The book appears to provide an answer to every question that a photographer, whether amateur or professional, might wish to ask during his first attempts at the process, even as to where the various items may be purchased. In order to render the volume more complete, the final chapter is devoted to the "Elements of Rotary Gravure," and on the last page Mr. Bennett says that he "does not hesitate to name rotary gravure as the best all-round solution of two and three colour photo-printing." Flat plate gravure is not well adapted for the superposition of two or more impressions, because the damping of the paper renders registration difficult on account of its expansion thereby, and because the capacity of the paper to pick up copper plate ink is much diminished after its first pull through the press.

Biology. By O. H. Latter. ("Science for All" Series.) Pp. vii + 197. (London: John Murray, 1926.) 3*s.* 6*d.*

THIS book may be confidently recommended wherever biology is taught as a subject of general education. Mr. Latter's long experience of biological teaching is an assurance that from the wide field of possible topics his choice will be a wise one, and his book is, in fact, a notable success. Its chapters are linked by the principles of the dependence of living things on one another, and their adaptations to their surroundings. Since it is assumed that time will not be available for general practical work, each chapter ends with a suggestion of suitable demonstrations, which need no special equipment beyond a few microscopes. Two features of the book will make it particularly helpful to its readers—its clear diagrams and Mr. Latter's practice of giving the Latin or Greek derivation of all technical words. He thereby removes, as nearly as possible, one of the chief difficulties of a young biologist—that of mastering the terms in which the science is described.

Grundzüge der mathematischen Erdkunde. Von Prof. Dr. Georg Wegemann. (Sammlung Borntraeger, Band 9.) Pp. 184. (Berlin: Gebrüder Borntraeger, 1926.) 6·60 gold marks.

PROF. WEGEMANN'S book is a compendium of astronomical and geodetic knowledge. It is mainly descriptive, with abundant numerical data; formulæ are quoted but not proved. Time measurement, including many systems not prevalent in modern Europe, the form and motions of the earth, astronomical errors of observation, and the nature of the principal perturbations of the moon's motion, are a few of the varied topics treated.

An Introduction to the Calculus. By Clement V. Durell and R. M. Wright. (Cambridge Mathematical Series.) Pp. vii + 91 + xi. (London: G. Bell and Sons, Ltd., 1926.) 2*s.* 6*d.*

THIS is a reprint, with slight modifications, of the section on calculus in Part 2 of the authors' "Elementary Algebra." The course meets the requirements of the School Certificate Examination conducted by the Oxford and Cambridge Joint Board.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Kerr Effect in Wireless Transmission.

MR. HOLLINGWORTH'S observations (NATURE, Sept. 18, p. 409) on the polarisation of long wireless waves by day and by night are of great interest in connexion with the attempts which have been made to explain the diurnal variation of atmospheric influences on wireless transmission.

According to the original theory of diurnal variation proposed by Dr. Eccles (*Proc. Roy. Soc.*, A, vol. 87, p. 79, 1912), atmospheric deviation of wireless waves is produced during the day by ionic refraction in a somewhat diffuse layer in the middle atmosphere, while at night true reflection of all wave-lengths takes place from the sharp boundary of the Heaviside layer in the upper atmosphere. According to this theory, the difference between the 'reflection coefficients' of the day and night layers is due to the difference in the degree of variation of ionic content of the under boundaries of the layers.

More recently (NATURE, March 7, 1925; *Electrician*, April 3, 1925) a somewhat different theory has been found useful in linking the mass of evidence relating to geophysical influences on wireless transmission which has accumulated during the last few years. According to this view, the increase of signal strength at night, which is noticeable particularly on the shorter waves, is attributed not to an increase in ionic gradient but to a general lifting of the layer after sunset The reduction in the collisional 'friction' of the electrons in the layer, due to the increased height and lower pressure, makes deviation with reduced absorption possible In this connexion it seems clear that the difference between reflection and refraction is determined by the ratio of the thickness of the transitional layer to the wave-length, and, since a transitional layer of several kilometres is contemplated both by day and by night, we may generalise roughly and say that long wireless waves are deviated by reflection and short waves by refraction. The gradient of conductivity (which is determined not only by the gradient of ionic content, but also by the gradient of τ, the time between two collisions of an electron with the gas molecules) is sufficiently high to deviate long waves within a wave-length, while the shorter waves are deviated by ionic refraction brought about by a diminution of the refractive index Experimental evidence is steadily accumulating which shows that in the latter case ionic refraction without absorption is only brought about, as Sir Joseph Larmor first predicted on theoretical grounds, when the frequency of the waves is higher than the frequency of the electron collisions with gas molecules.

In linking up these ideas with the magneto-ionic theory, in which the effect of the earth's magnetic field on the motion of the electrons is taken into account, a Kerr effect was predicted (*Proc. Camb. Phil. Soc.*, vol. 22, Part 5, p. 675, 1925) for long waves when reflected by the ionised layer at night. Mr. Hollingworth's observations on long waves seem to show that such an effect is appreciable. Considered in conjunction with Dr. Smith-Rose and Mr. Barfield's observations with the Adcock system, they also constitute another confirmation of Mr. T. L. Eckersley's theory of the nature of directional errors.

A consideration of the magneto-ionic formulæ for the conductivity and dielectric constant of ionised gas shows that, in cases of reflection, there is a certain critical height in the atmosphere above which the conductivity in the direction of the earth's lines of magnetic force is appreciably different from that in a direction at right angles. This is the height at which the frequency of the electron collisions with gas molecules is equal to the angular frequency with which the electrons normally spiral round the lines of magnetic force. Taking the earth's field as 0·5 gauss, the critical value of τ is found to be equal to 10^{-7}. Estimates of both mean free paths and air pressures at different heights in the atmosphere, as given by different writers, vary somewhat, but from the available data we may, using the above value of τ, put the critical height somewhere about 70 km. to 80 km. When the waves are deviated below this height, practically no abnormal polarisation is produced, but when deviated above, both Kerr and Faraday effects will be produced according to the wave-length. The fact that the Kerr effect is found at night and not by day indicates that the ionised layer passes from or below this critical region to a height appreciably above it at sunset. Current determinations of the height of the layer for these wave-lengths by day and by night support this conclusion.

E. V. APPLETON

Wheatstone Laboratory,
King's College, London,
September 21.

Early Egypt and the Caucasus.

As the careful summary of the meeting on this subject at Oxford (NATURE, September 25, p. 463) stops short before my reply to the difficulties there raised, I trust that I may be allowed to complete the report. We must consider the reasons for retaining the view of the dependence of the Fayum on the Nile flow, which has been held by engineers, geologists, and historians during the last fifty years—much of history depends on the conclusions.

The essential question is to choose between the received view (*a*) that the Fayum lake gradually rose by the rise of Nile level up to 205 or 220 feet over the present lake, and was suddenly dried up by restricting the inflow, under the Ptolemies; or the new view (*b*) that there was a high lake in the early human period, which was gradually dried down to the present size. The complete drying up would not take more than twenty-five years.

For the view (*a*) there are six reasons. Physically there is (1) an open channel from the Nile, the mud in which is at least as low as the Nile was at 5000 B.C., and it is unlikely that this would become blocked when a large mass of water was flowing to and fro every year. (2) It would be impossible to maintain a lake at high level unless fed by the Nile, the adjacent deep basin of Wady Rayan has not had any historical lake, because there is no Nile inflow. Historically we see (3) there are an early cooking-pot, fire, and flints *in situ* at 170 feet level, while the water in Greek times must have been up to over 200 feet, by a site being called the "crocodile island," so the lake level was rising and not falling (4) There is no trace of human work anywhere below the Nile level of its own age, which points to the lake covering the ground up to Nile level. (5) There are four structures of stone, all at the same level, which cannot be reasonably explained except as quays of late origin, and these are at 215 feet level, showing the late lake to have been far above the early flint work. (6) Direct evidence is that of Herodotus; he states

that the water flowed for half the year out of the lake to the Nile, and he names the different amount of tax on fisheries during the inflow and outflow. These reasons for the old view (*a*) seem to outweigh the interpretation of traces of the lake levels, after 2000 years of denudation which are adduced for the new view (*b*).

The geologists made objections, which were unfortunately irrelevant, as to the relation of Badarian to Solutrean culture; for it would be useless to expect that different branches from one culture, travelling 3000 miles apart under very different conditions, should retain the same details.

Permit me to add a parallel to the view of there having been an Asiatic centre of distribution for the Solutrean, Badarian, and some western neolithic culture. In the thirteenth century there were European settlers in Greenland, who were later exterminated by advancing cold, and savage Eskimos, much as Solutreans were exterminated in Europe. In the seventeenth century the same race settled in Greenland again and in New England. An American archæologist in future might say that no resemblance could be seen between these invasions, the clothing of the first age was different from that of the second, the architecture and arms of the second age were unknown in the first. Yet we know, from fuller detail, that they were of one race and one culture. Differences do not count in such a question; resemblances are the trustworthy facts.

There were five independent subjects noticed at the above meeting, each of which has to be judged on its own evidence, and the settlement of one subject will not prove or disprove any of the others, though they are closely connected in results.

FLINDERS PETRIE.

Variability of Species.

THE writers have, on one hand, been examining the variability of thirty-five species of Lepidoptera, chiefly common British moths, and, on the other hand, studying the variation to be expected theoretically in a population exhibiting inheritance wholly on Mendelian lines, with the corresponding appropriate mutation frequencies, under the influence of natural selection. The conclusions at which they have respectively arrived show a sufficiently striking agreement to suggest a theory which may be generally applicable to the natural variability of wild species.

The actual variance exhibited is regarded as having been arrived at as an equilibrium condition between the action of mutations tending to increase variability, and of selections tending to diminish it. If in such an equilibrium the mutation rates, and also the selection rates, were the same for all species, then the variance would be proportional to the population of the species. We know of no reason for supposing that the mutation rates are different for species differing in abundance, but it is *a priori* probable that in abundant species individual survival is less fortuitous, and more selective, than in rare species; while it is easily demonstrable that in species in which a higher proportion of the total variance is ascribable to genetic causes, the effective selection will be more intense than in species in which the variance is to a larger extent ascribable to environmental variations. On these grounds we should expect the more abundant species to be, in fact, the more variable, though to an extent which can only be ascertained by observations.

Charles Darwin ("Origin of Species," Chap. ii.), in studying the causes of variability, attempted a statistical investigation of material relating to a large number of different species of plants. He was, perhaps unfortunately, dissuaded from publishing his actual tabulations, but gained the concurrence of Hooker to the general conclusions that "wide ranging, much diffused, and common species vary most." Darwin was concerned to show that it was not merely that wide ranging forms give rise to local varieties in reaction to different inorganic and organic environments, but also that, "in any limited country, the species which are most common, that is, abound most in individuals, and the species which are most widely diffused within their own country (and this is a different consideration from wide range, and to a certain extent from commonness), oftenest give rise to varieties sufficiently well marked to have been recorded in botanical works."

The accompanying observations concern not "well marked varieties," but individual variation in a continuously variable character, namely, depth of pigment of the ground colour of the forewing, the variability found being that exhibited in each case in a single locality. As is shown in Fig. 1, the average variance of the abundant species is almost double of that of those species which are comparatively uncommon;

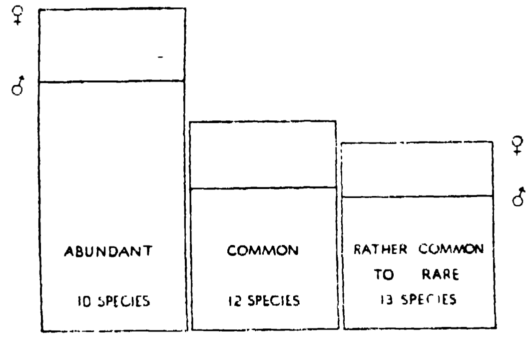

FIG. 1.

the values for males and females are shown by the lower and upper lines, the agreement of which gives some indication of the statistical trustworthiness of the results.

The data thus supply a complete confirmation of the conclusion arrived at on purely theoretical grounds; moreover, the fact that Darwin's observation with respect to "well marked variations" should be equally applicable to continuous variation would be unintelligible if, as is sometimes assumed, continuous variation had some origin distinct from the familiar Mendelian mutations.

Finally, the female moth is distinctly the more variable, the difference being nearly constant at about 38 per cent. for all degrees of abundance; this fact supplies a confirmation of theoretical anticipations of an unlooked-for kind. It has been argued (*e.g.* G. Dahlberg, "Twin Births, etc.," p. 231) that the sex with the greater number of sex chromosomes should therefore show the greater variability; a closer examination shows that this consequence will follow only if the dominant gene is, in the population concerned, generally less numerous than the recessive. (It should be noticed that this does not imply that the dominant genotype is generally the less numerous.) Our previous investigations (Fisher, 1922, *Proc. Roy. Soc. Edin.*, 42, 321) have, however, shown that in any character subject even to small selective influences the recessive gene will nearly always be the rarer. Consequently the heterogametic sex, which is the female in moths, should be the more variable, since a single recessive factor exercises its full effect

in an XY chromosome pair, though in all other cases it requires also a recessive partner. Numerically, on the simplest assumptions, we should expect the variability due to the sex chromosome in the heterogametic sex to be increased by about 9·86 per cent., while that of the homogametic sex should be diminished by 27·47 per cent. The difference is 51 5 per cent. of the smaller value, and on comparing this with our observed difference of 38 per cent. it will be seen that either additional causes must be sought for the striking excess of female variation, or the greater part of the variation present must be ascribed to the sex chromosome, which is unlikely.

Whatever may be the explanation of this great apparent activity of the sex chromosome, the two main inferences from the statistical study of the effect of Mendelian factors under selection, (1) that variability in any one locality is greater for the more numerous species, (2) that it is greater in the heterogametic sex, have both been unmistakably verified in the body of material which we have examined.

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The Atomicity of Electricity as a Quantum Theory Law.

IN the five-dimensional theory of the connexion between electromagnetism and gravitation first proposed by Th. Kaluza (*Sitzungsberichte d. Berl. Akad.*, 1921, S. 766, see also O. Klein, *Zs. fur Phys.*, 37, 875, 1926), the equations of motion of an electrified particle may be shown to be the equations of geodetics belonging to the following line element:

$$d\sigma = \sqrt{(dx^0 + \beta\phi_i dx^i)^2 + g_{ik}dx^i dx^k}, \qquad (1)$$

where x^1, x^2, x^3, x^4 are the co-ordinates of ordinary space time with the line element $g_{ik}dx^i dx^k$, while x^0 is a fifth co-ordinate, and the ϕ_i are the four co-variant components of the electromagnetic potential vector. If the constant β is given the value

$$\beta = \sqrt{2\kappa}, \qquad (2)$$

κ being the Einstein gravitational constant, the 14 field equations of the Einstein theory may, moreover, be simply expressed by means of the curvature tensor belonging to this line element.

Let now $d\tau$ be the differential of proper time belonging to a particle of mass m and charge e; then the Lagrange function L for the geodetics representing the motion of the particle may be given the form

$$L = \tfrac{1}{2}m\left(\frac{d\sigma}{d\tau}\right)^2. \qquad (3)$$

Defining momenta in the ordinary way by putting

$$p_i = \frac{\partial L}{\partial(dx^i/d\tau)} \qquad (i = 0, 1, 2, 3, 4), \qquad (4)$$

p_0 is seen to be constant along a geodetic, since x^0 does not appear in L. In addition to the equation expressing this constancy, the system belonging to (3) contains four equations which indeed become identical with the equations of motion of the particle if we put

$$p_0 = \frac{e}{\beta c}. \qquad (5)$$

With this choice of p_0 the momenta p_1, p_2, p_3, p_4 are further seen to agree with the ordinary definition of the momenta of an electrified particle.

Now the charge e, so far as our knowledge goes, is always a whole multiple of the electronic charge, so that we may write

$$p_0 = \frac{N\epsilon}{\beta c}, \qquad (6)$$

ϵ being the electronic charge and N a whole number, positive or negative. This formula suggests that the atomicity of electricity may be interpreted as a quantum theory law. In fact, if the five-dimensional space is assumed to be closed in the direction of x^0 with a period l, and if we apply the formalism of quantum mechanics to our geodetics, we shall expect p_0 to be governed by the following rule:

$$p_0 = N\frac{h}{l}, \qquad (7)$$

N being now a quantum number, which may be positive or negative according to the sense of motion in the direction of the fifth dimension, and h the constant of Planck. Comparing (7) with (6), and making use of the value (2) of β, we get for the period l:

$$l = \frac{hc\sqrt{2\kappa}}{e} = 0{\cdot}8 \times 10^{-30}\ \text{cm}. \qquad (8)$$

The small value of this length together with the periodicity in the fifth dimension may perhaps be taken as a support of the theory of Kaluza in the sense that they may explain the non-appearance of the fifth dimension in ordinary experiments as the result of averaging over the fifth dimension.

In a former paper (*Zs. für Phys*, *l.c.*) the writer has shown that the differential equation underlying the new quantum mechanics of Schrödinger can be derived from a wave equation of a five dimensional space, in which h does not appear originally, but is introduced in connexion with a periodicity in x^0. Although incomplete, this result, together with the considerations given here, suggests that the origin of Planck's quantum may be sought just in this periodicity in the fifth dimension

OSKAR KLEIN.

Copenhagen, September 3

The Rôle of the Cerebellum in the Co-ordination of Animal Movement.

THE intracerebellar nuclei, forming, as they do, important stations on the course of the cerebellar reflex arcs, naturally invite inquiry as to the kind of influence they exert on the muscles. Our observations have been made on the cat, decerebrated in deep anæsthesia according to Sherrington's original technique, the plane of transection of the neuraxis passing just in front of the superior colliculus and in front of the infundibulum, thus leaving intact the *nucleus ruber*. Horizontal slices were then removed from the cerebellum on one or both sides, so as to expose for stimulation the dorsal surfaces of the nuclei Measures were taken to arrest the bleeding and to maintain the proper temperature. The approximate position of the nucleus in question having been determined by measurements, the section of cerebellum in this neighbourhood was then carefully explored with minimal currents applied by a unipolar electrode The following is a brief résumé of our results obtained by stimulation of the several nuclei.

Faradisation of the outer side of the *nucleus dentatus*.—This yielded repeated flexions at the elbow of the ipsilateral foreleg, when the limb was already somewhat flexed owing to the cerebellar removal; the limb was also abducted. Results of this kind were obtained by Horsley and Clarke. The contralateral foreleg, previously in slight extension, showed adduction with palmar flexion of paw. The

hindlegs already extended became more rigid in extensor tone.

At times the ipsilateral foreleg passed from flexion into extension on stimulation of the dentate nucleus; or if originally extended the effect of stimulation was to diminish the tonus. Similarly the hindlegs sometimes showed an inhibition of their tonic rigidity. The tail has been seen to point opposite to the stimulation, whilst the body was curved with the concavity contralateral.

Faradisation of the *nucleus emboliformis*.—This elicited in the ipsilateral foreleg, when previously slightly flexed, more marked flexion at elbow and paw together with adduction. The contralateral foreleg already rigidly extended showed diminished tonus. The ipsilateral hindleg showed inhibition of extensor tonus, the contralateral hindleg increased extensor tonus. The ipsilateral foreleg when originally extended showed inhibition of tonus. The tail was elevated and rotated rapidly. The eyeballs were rotated on the visual axes, the upper parts turning towards the stimulation.

Faradisation of the *nucleus fastigii*.—Manifestations consisted in strong flexion of both forelegs, already somewhat flexed in consequence of the cerebellar ablation; the toes were spread apart. The ipsilateral hindleg was flexed, the toes being separated.

Obviously, from these results, stimulation of the nuclei may yield either an increase or a diminution of tonus, the outcome apparently depending on the functional state, whether of activity or depression, of the infracerebellar centres. It is known that certain regions of the cerebellar cortex yield on stimulation inhibition of muscular tone, and, since these regions are linked with the internal nuclei, the inhibition elicitable from these latter becomes intelligible; thus support is furnished for a doctrine of cerebellar function recently enunciated by one of us, namely, that control of postural tone by the cerebellum may be either in the direction of augmentation or of inhibition (*Physiol. Rev.*, 6, 124, 1926).

FREDERICK R. MILLER.
N. B. LAUGHTON.

Department of Physiology,
University of Western Ontario,
London, Canada, August 23.

The Action of Silica on Electrolytes.

IN a letter to NATURE (January 2, p. 17, 1926), Dr. Joseph suggests that I have modified my point of view. I am rather more confirmed in it. There are really two points at issue between Dr. Joseph and myself. (1) Dr. Joseph holds the view that our usual conception of ionic equilibrium in heterogeneous systems is sufficient to account for the liberation of acids when hydrated silica reacts with electrolytes (*J.C.S.*, 1923, **123**, 2022; 1925, **127**, 2813). We consider the reaction to be an example of an equilibrium between ions in the double layer and those in solution. As stated in my previous letters to NATURE, we believe that the surface primarily adsorbs anions. (2) Consequently the adsorption of acid by hydrated silica is also to be expected.

I shall take up the second point first. Dr. Joseph denies the existence of what we call 'primary' adsorption. This adsorption is to be calculated after taking into account the diluting effect of water of hydration (*Phil. Mag.*, vi. 44, 1922, p. 337). From the data given in my letter in NATURE of January 31, 1925, it would appear that the water of hydration cannot account for a diminution in concentration of about 90 per cent. The amount of primary adsorption is small and is found to be of the order of 10^{-4} gram moles of hydrochloric acid per gram mole of silicon dioxide. The failure of Dr. Joseph to confirm our results is to be ascribed to his having used 1 gram of silica and 100 c.c. of solution.

The smallness of the amount of adsorption is not against our point of view, as the adsorption of other anions is likely to be less than that of hydroxyl ions. We have observed that the total amount of acids that can be liberated from these samples of silica by repeated washing with saturated solution of potassium chloride is 6×10^{-4} gram equivalents of acid per gram mole of silica (*Quarterly J. Indian Chem. Soc.*, vol. 2, 1925, 211).

We shall now deal with the first point. In his second paper (*loc. cit.*), Dr. Joseph observes that calcium silicate is more insoluble than the corresponding barium salt. Dr. Joseph also states that solubility relationships explain the observations regarding the interaction between silica and neutral electrolytes. On this basis it is to be expected that under identical conditions calcium should, in contact with silica, liberate hydrogen ions at a higher concentration than barium chloride. On the other hand, from theoretical considerations of the effect of these cations on the electric charge of the surface of hydrated silica, barium should have a greater effect than calcium, and consequently barium should liberate hydrogen ions at a greater concentration. This is what we have observed, and I think the observation cannot be explained from Dr. Joseph's point of view based on considerations of solubility as usually applied to such reactions.

We have also observed that at higher concentrations individual differences between different cations decrease. Here also solubility relationships fail even if we consider the formation of some sort of solid solution. Besides silica there are other systems, *e.g.* manganese oxides, which behave similarly.

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The British Patent Office.

IT is to be hoped that the arguments in the leading article in NATURE of September 18, for reforms in the patent system which would increase the chance of an issued patent being valid, will have effect.

It is undoubted that the value of a patent would be increased if the British Patent Office were given greater powers by the enlargement of the field of the investigation made as to novelty and by allowing the Patent Office to pronounce on the question of quantum of subject matter. The Patent Office examiners in Germany, for example, have this power, so why not those in England? It is common experience that the investigation as to novelty now made by the Patent Office examiners is, within the limited powers granted to them, more efficiently carried out than in any other country. One difficulty in the way of allowing the Patent Office to give a definite decision on validity is not so great as it appears. It is very doubtful whether 'prior user' alone is often the determining factor in deciding the invalidity of a patent. In most cases the relevant process or article has been described also in a patent specification or in text books or periodicals of the art. It is to be noted that in Holland, where the powers of the Patent Office examiners are great and their attitude towards claims strict, the validity of a patent is guaranteed after five years' freedom from successful attack.

It would help to inspire confidence in the worth of

a patent, even under the present system, if the examiners in the Patent Office were to be more strict in their requirements as to the clear and precise definition of an invention and the distinguishing of it from the prior art. At present a patent agent can usually form a correct opinion from reading a specification as to its scope, but the ordinary manufacturer, however 'skilled in the art' he may be, must frequently find himself at a loss. It requires no fresh legislative powers for the Patent Office to require an applicant to state unequivocally what is the monopoly claimed in terms which, whilst appealing rather to a craftsman than a lawyer, would yet be precise enough to satisfy the latter.

This defect is probably due to the attitude of 'leave-it-to-the-Courts' which is a relic of the days before the Act of 1902 came into force, and would tend to disappear if it were established that the greatest possible assurance of the validity of a granted patent were to be striven for, and that only in the very last resort should patent matters come before the Court.

ERNEST E. TOWLER.

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Apocryphal Medical Science.

OUR attention has been directed to a book called "Microbe Hunters" recently published by Messrs. Harcourt, Bruce and Company, New York, and alleged to have been written by one Paul de Kruif—a gentleman whose name is quite unknown to us. The work evidently aims at being a kind of popular history or rather romance regarding medical discovery, and mentions us among others. We should like an opportunity to say, for the information of readers of NATURE, that the author's statements about ourselves and our researches are almost entirely apocryphal; that they are not supported by reference to the original literature; that they are largely imaginative or spurious; and that his knowledge of the subjects with which we have been concerned is obviously incomplete.

We have been legally advised that some of his assertions regarding ourselves are libellous according to British laws; but in America we have no means of protection except a public denial of the truth of his allegations, and we therefore trust that we may be allowed to publish such a denial, as emphatically as we may, in the columns of NATURE.

Dr. Cuthbert Christy's signature does not appear on this letter, as he is in Africa; before sailing, however, he left us the following statement: "With regard to Chapter IX. of Paul de Kruif's book 'Microbe Hunters' I beg to emphatically state that it contains statements which are totally erroneous, misleading and some of them libellous. As an example I will quote paragraph 2, page 264, which reads: 'The third member' (namely, myself) 'became disgusted with the ignorance and failures of his two colleagues and went off prospecting for rubber. . . .' This paragraph is absolutely untrue and libellous. It suffices to say that I have always given credit to Castellani for his discovery of the trypanosome as the etiological agent of Sleeping Sickness—see for instance my letter to the *Morning Post*, August 22, 1923. As regards my abandoning my colleagues and going off prospecting for rubber, this is entirely libellous. I never abandoned my colleagues and, as a matter of fact, I did not get interested in rubber until 1906, which was three years after the labours of the First Sleeping Sickness Commission were completed."

ALDO CASTELLANI.
GEORGE C. LOW.
DAVID NABARRO.
RONALD ROSS.

Kammerer's Alytes.

As I have been both misquoted and misrepresented by Prof. MacBride in a recent letter to NATURE (August 21, p. 264), I may be permitted to say a word in my own defence. My remarks on Kammerer's Alytes at the British Association were to the effect that the sections sent by Dr. Kammerer to America showed only asperities, not distinctive glands characteristic of the nuptial pads of other Salientia. The glands in his sections of the controls were the same size as those in his experimentals. Asperities may be formed on different parts of the body in one or both sexes of different species of frogs, and in some cases are apparently not correlated with a sex hormone. In the case of Kammerer's results, the question concerned the inheritance of spines, not of complete pads. Prof. MacBride seems to believe there has been some confusion in my mind on this subject.

In regard to the only specimen in existence of Kammerer's experimentals exhibiting merely a "clumsy attempt at 'faked' restoration," made "after its return to Vienna," we have Kammerer's own word that the blackened areas were present in the specimen when it went to England (Przibram, 1926, NATURE, August 7, p. 210), and moreover these areas are the only "nuptial pads" which show up in the photograph made in Cambridge (Kammerer, 1924, "The Inheritance of Acquired Characteristics," New York, Fig. 9) or in the one made in Vienna (Kammerer, 1919, *Arch. f. Entwicklungsmech.* 45. plates x-xi). Further, these blackened areas deceived two able biologists in Vienna who examined the specimen in my presence.

The question of Proteus is, of course, entirely irrelevant. The young Proteus possesses eyes, and the mere fact that certain individuals due to an irregularity of development, whether or not casually connected with an abnormal environment, should have continued the development of these structures, has no bearing on either the question of the inheritance of acquired characters or of Kammerer's experiments with Alytes.

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Variation of Penetrating Radiation on the Jungfrau.

OUR new researches on the penetrating radiation in the region of the Jungfrau have now reached a partial conclusion. As is well-known, the existence of this radiation was proved by balloon observations in the years 1909 1914, and, in particular, their extraordinary hardness, which pointed to a cosmic source, was then established by Kolhörster. Afterwards, Nernst in 1921 suggested that their origin lies in recently formed matter. Our researches in 1923–1924 did, in fact, give indications of a sidereal periodicity of intensity of the radiation. These variations can now be closely followed with our more sensitive instruments. It appears that the radiation reaches maximum intensity when certain celestial regions culminate, for example, the Milky Way, and specially the regions of Andromeda and of Hercules. This is explicable as a consequence of the minimum length of the path of rays from these regions through our atmosphere at culmination. The measurements were made at different stations on the Jungfrau up to heights of 14,000 feet, and on the Mönch peak at 13,500 feet above sea-level. Glacier ice was in general used as screening material.

W. KOLHÖRSTER.
G. VON SALIS.

September 14.

Function and Design.[1]

By Prof. J. B. LEATHES, F.R.S.

AMONG natural sciences physiology takes a place which in one respect is different from that taken by any other. It studies the phenomena of life, but more particularly the ways in which these phenomena are related to the maintenance of life. Anatomy and morphology are concerned with the forms of living organisms and their structure; biological chemistry, as distinct from physiology, with the composition of the material in which the phenomena of life are exhibited. The province of physiology, in studying the functions of these forms and of this material, is to ascertain the contributions that they make to the organisation of the living mechanism, and learn how they minister to the maintenance of its life. Function implies ministration; structure for physiology implies adaptation to function, what, in a word, may be termed design.

Ultimate analysis of the phenomena with which physiology deals leads to the fundamental distinction between matter in which life is manifested and matter in which it is not. Life is exhibited only in aqueous systems, containing unstable, perishable combinations of carbon with hydrogen, nitrogen, sulphur, phosphorus and oxygen, in the presence of certain inorganic ions, those which are present in the sea, the native environment originally of all forms of life. The inalienable property that such matter exhibits when alive, and that matter which is not alive does not, is that these unstable organic combinations are for ever reforming themselves out of simpler combinations that do not exhibit this property, and do so at a rate which averages at least not less than that at which they break down. This power of self-reformation, spontaneous regeneration, operates not only when living organisms, cells or communities of cells are growing or reproducing their kind: the very maintenance of living existence requires by definition that it should persist. In the absence of water, the living process may sometimes apparently be suspended for a time, as it may be if the surrounding watery medium is immobilised by cold; it is a question whether this is anything more than a retardation to a rate of change that is imperceptible by the ordinary methods of observation, and a question how long such suspended animation is possible where it is possible at all.

Chemical analogies for this power of spontaneous regeneration, if such exist, can only exist in part: in the present state of our comprehension of it, certainly, it is hazardous to try to trace them. The attempt so commonly made to trace one between the growth of living matter and the growth of crystals in a saturated solution, it is safe to say, is in so many respects on the wrong lines that it is merely misleading.

Let us for a moment consider what this spontaneous regeneration implies. Of the various chemical components of protoplasm, proteins are generally considered the most important, often the only important, ones. The elucidation of the chemical principles upon which the structure of proteins rests, which took place about the beginning of this century, was, like the neurone hypothesis of the structure of the nervous system, an advance the magnitude of which only those, perhaps, can appreciate who began the study of physiology well back in an earlier one. For a time it seemed in each case that the problem was solved and all that was to follow was simple. Those were great days.

The best-known varieties of proteins, when detached and uprooted from the place where they grew, consist of chains of about a hundred, sometimes nearly two hundred, links. Each link is an amino acid coupled by its acid group to the amino group of one neighbour and by its amino group to the acid group of its other neighbour, a molecule of water being lost at each linkage. There are not more than about twenty different amino acids, so that some of them must occur several times in the chain; in some kinds of protein one amino acid may occupy thirty or forty of the hundred places in the chain. In any such isolated protein it is probable that the order as well as the proportion in which each amino acid occurs in the molecule is fixed, and it is this specific order and proportion that accounts for the specific character and properties of the protein. What could be simpler? Only yesterday all was so obscure.

It is not recorded that in the rush of this advance any one stopped to reflect what number of formations such a protein might still possibly have. Supposing it were a chain of only fifty links, a very simple case; if all the links were different, the number of possible permutations is denoted by the innocent-looking symbol $|\underline{50}$. If, instead of all being different, one kind of link recurred ten times, the number would be reduced to $|\underline{50} / |\underline{10}$. If, in addition, there were four that recurred four times and ten that recurred twice, it would be further reduced to

$$|\underline{50} / |\underline{10} \times (|\underline{4})^4 \times (|\underline{2})^{10}.$$

It would now consist of a chain of only fifty links, of which there were only nineteen different kinds, and the number of different arrangements of its parts would be about 10^{48}. Astronomy deals with big figures. Light, it is said, takes 300,000 years to travel from one end of the Milky Way to the other; this distance expressed in Ångström units, 10,000,000 of which go to a millimetre, would be less than 10^{32}. So far are we from knowing the structure of protein molecules! So far are we from knowing what variations in disposition of the parts in such a molecule may not occur without our being within a measurable distance of detecting them! For if the number of possible varieties of a protein the molecular weight of which is known, and known to be exceptionally small, which contains the several amino acids in a known proportion, is so great as this, the number that is possible when that proportion may be changed is practically incalculable, each change in proportion being capable of a number of new arrangements that could be calculated, as was done for our hypothetical case.

Now it is possible that the analogy of crystal formation may be applied to the reproduction of the characteristic order in which the linkings occur, and that the parts out of which a new chain is to be formed may

[1] From the presidential address to Section I (Physiology) of the British Association delivered at Oxford on August 5.

be collected and brought into position alongside of the corresponding parts of an existing chain by forces that are similar to those that determine the latticed relations of atoms in a crystal. But something more than this is required to account for the linking up of these links by the loss of water, and still more for the fashioning of the links themselves. We have to suppose that it is by selective emphasis of certain otherwise unemphasised but possible arrangements of atoms or groups of atoms, evidence for the occurrence of which under similar conditions in the absence of life is generally not obtainable. Specific catalysed syntheses must cooperate with the forces that merely sort out and place in proper order the assembled parts, and must fashion for them the particular links that they need at each step. Specific catalytic agents playing an important part in cell chemistry are familiar in the enzymes found in digestive secretions and also locked away within the cells themselves.

In the chemical make-up of protoplasm, proteins, the most abundant component, are not the only ones that are necessary. Pre-eminent among the others are the nucleic acids. When we consider what has been learnt of the behaviour and of the chemical composition of the nuclear chromosomes, and that according to Steudel's reckoning the nucleic acids form 40 per cent. of the solid components of these chromosomes, into which are packed from the beginning all that pre-ordains, if not our fate and fortunes, at least our bodily characteristics down to the colour of our eyelashes, it becomes a question whether the virtues of nucleic acids may not rival those of amino acid chains in their vital importance. From Steudel's figures it can be reckoned that there are about half a million molecules of nucleic acid in a single sperm cell of the species with which he was working.

In addition to nucleic acids there are also strange compounds of higher fatty acids containing suspiciously significant groups, identical in their general character with those found also in nucleic acid, namely, phosphoric acid, organic bases and sugar; and besides these there are the mysterious sterols. All of these are frankly insoluble in water, and yet have in some part of their composition features that make them not indifferent to water or even to the molecules and ions that exist in true solution, in the liquid state, within the cell. The physical condition of these insoluble substances in the aqueous system of the cell is still little understood. All that can be said with certainty is that they must modify its homogeneity even more than the long floating chains of amino acids, however much these may be linked together one with another. If the characteristic behaviour of living matter is rightly regarded as due to the order that it introduces into the movements and spatial relationships of foreign molecules in its vicinity, then these insoluble components may well be expected to play a leading rôle by forming films and surfaces that permeate its texture and delimit its parts.

If this analysis is approved and the distinctive property of living matter, the power of self-regeneration, depends upon the power of limiting the movements and directing and controlling the spatial relations of surrounding molecules so as to modify their chemical behaviour, it is the exercise of this same power that leads to the formation of substances such as starch, glycogen and fats; and in so far as such substances contribute to the regeneration of the living matter, the power of forming them contributes to its survival. Where energy is necessary for such synthetic rearrangements of adjacent matter, it may be derived from the radiant energy of the sun or from the combination of oxygen with adjacent organic matter.

This faculty of regeneration implies the power of introducing order into the chaotic movements of adjacent matter in conformity with patterns that it possesses. It is a faculty resident in material that is capable of incalculable variation. The number of permutations of its parts that are possible without affecting the results of such analysis as is practicable defies calculation. Some of these permutations confer synthetic powers which others do not. When they appear, are they not what biologists call, for short, mutations? But when they appear, if they retain the power of self-regeneration, and if they minister to its maintenance, they will *ipso facto* survive. For whatever promotes persistence of this power must itself survive.

A disposition of matter in molecules or aggregates, unstable and incalculably variable, that has and retains the power of determining the disposition of matter not yet so disposed, in such a way as to conform to its own disposition or to patterns which help it to exercise this power, is all that must be premised for the whole of evolution to follow. Variations that do not or cease to contribute to the retention of this power do not survive. The condition of survival is ministration to self-regeneration, that is, to the maintenance of life.

Before the days of vertebrates, in pre-Silurian time, an unstable variation occurred in certain types in the disposition of atoms and organic combinations of atoms that was mainly protein in character, a protein to the making of which little short of 200 amino acid links must contribute. Coupled to this protein, which probably is not the same in all species of animals in which it is found, is another group containing iron that is probably always the same. This group is of remarkable nature, and is closely related to one that occurs in the far older substance chlorophyll. This complex substance hæmoglobin had the power of attaching to itself two atoms of oxygen for each atom of iron that it contained in such a way that it could be readily detached and made available for effecting oxidations. Such was the service that this variation rendered that it is safe to say that without it there could be no vertebrate creation. It is this service that has made it possible for it to survive to this day, when in the human species alone it is being produced at the rate of about 10,000 tons a day. The story of the service of chlorophyll would, of course, be more remarkable than this.

Natural selection applies to the survival of the chemical forms of living matter as it does to complex living organisms. These forms, infinitely protean in their variety, survive and persist in so far and so long as they minister to its self regeneration. It is the principle of survival by service. Function alone gives permanence to structure.

Why is it that what may be termed official physiology takes so little cognisance of the doctrine of evolution?

These branches of biological study appear to follow courses so exactly parallel that they never meet.

The doctrine of evolution digs down into the foundations of scientific philosophy. If a physiologist addressing physiologists ventures to say anything on this subject of supreme appeal to all biologists, it must be in exaltation of the work of those who have approached it from the morphological side, and it may be in hopeful anticipation of the ultimate share in the elucidation of some of its problems to be borne by physiology.

On the part that function plays in the determination of structure it is to be supposed that physiology will ultimately, at any rate, have something more to say. May I submit to the consideration of physiologists certain points in the physiological development of the machinery of the body where, unless I am mistaken, it is possible to detect the operation of function in determining the design of the machine?

The properties and behaviour of cells result from the properties of the material composing them. When a muscle cell contracts this is, in general terms, a reversible rearrangement of its parts in response to some alteration in the distribution of forces within or about it due to a disturbance from without. Such reversible reaction to adequate disturbance is a property common in the material of which living cells are composed.

In addition to this reversible type of reaction there are irreversible reactions, characteristic of other kinds of cells, and it is what we call connective-tissue cells that I would consider here. There are several kinds of connective-tissue cells, but they are alike in that they produce and discharge into their vicinity material of a characteristic composition: in some of the commonest this material is chemically collagen, the substance out of which gelatine can be obtained. In course of time these cells come to be embedded in the material which they deposit about themselves and so form one kind of connective tissue. Cells capable of behaving in this way are found, however, which have not yet exercised their faculty; these fibroblasts are then undifferentiated wandering cells that have found no abiding place in the community in which they have their birth. What it is that makes them settle down and start producing the material in which they come to be embedded has never yet been determined. But the most striking structures to which they give rise are the tendons and aponeuroses that make the muscles fast to the bones, and the ligaments that bind the bones to one another. The material that they deposit is composed of inextensible fibres that lie, in the case of tendons at any rate, so exactly and exclusively in the line of the resultant of the tension set up in the muscle to which they attach themselves, that it is difficult to believe that the disturbance which starts them producing their characteristic secretion is anything else than the pull exerted on them by the muscle fibres to which they are attached: the recurring external disturbances that produce reversible states of tension in the muscle, indirectly producing in them an irreversible reaction, which consists in the discharge of material that by its inextensibility can transmit the tension along the line of the force that provokes its deposition.

In their simplest form, cells of this kind deposit the wavy fibres in areolar tissue which, when straightened out under the action of a displacing force, set a limit by their inextensibility to the dislocation of the part first affected, and so distribute the action of the displacing force over surrounding areas. It is interesting to note that the origin of cells of this kind has been traced to the mesothelium cells that line tissue spaces and serous cavities, the clefts that make the gliding displacements of parts over one another possible. The deposition of fibrous material seems here, as in the tendons and ligaments, to be the result of reaction to the recurring disturbances set up by displacements, such, for example, as those of the lungs, the alimentary tract, the heart and pulsating vessels, and the deposition occurs in the line of strains set up by the displacing forces. The service rendered by this behaviour of the cells is that the fibres which they deposit, in virtue of their inextensibility, limit the extent of displacement at any one point by distributing it to surrounding parts.

The other component of areolar tissue, the elastic fibres, is similarly produced by other cells. These fibres take a straight course between their attachments; displacements in the line of their deposition are rendered possible by their stretching, and are recovered from by their elasticity.

The contribution made by such cells to the fabric of the body appears to result from the recurring operation of disturbances, to which they react by depositing fibres along the lines of disturbance.

More striking are the properties of cells upon which the formation of the skeleton depends. The cells that make bone not only secrete fibrous collagen, but they also encrust the fibres with insoluble lime salts, and it has long been subject of comment that the rigid bone that results always comes to lie in the line of prevailing strains and stresses. The analysis of the structure, for example, of the head and neck of the human femur, by Wolff and others who have followed him, shows how strictly this is true. Calculations prove that no particle of bone lies anywhere but where the strains dictate. We can predict with certainty, it seems, that it will be found that bone cells are composed of material that in reacting to physical forces directs, in constant relation to the line of action of those forces, the deposition of the substances which make up this connective tissue. Bone can only arise where strains and stresses set up this reaction, and the greater the strain or stress the denser the deposit. When a bone is fractured many bone cells are dislodged, and in the abundance of nutriment that ruptured vessels supply, these cells, released from their imprisonment, multiply. At first the force of gravity and the twitching of muscles acting on the soft semi-fluid tissues between the broken ends of the bone supply stimuli that are indeterminate in direction, and such reaction as occurs results only in the formation of loosely ordered calcareous fibres: but even this soft callus gives some degree of rigidity, sufficient to restrict the strains gradually to more and more clearly defined lines along which in proportion a stronger reaction can take place.

Once it is established that bone corpuscles react to strain and stress by discharging collagen, the intimate spatial disposition of which, as well as of the lime salts with which it comes to be encrusted, is determined by the directing forces to which it is exposed; and once it is recognised that the law of spontaneous regeneration requires that this reaction will persist in proportion to the prevalence of these forces, not only must the gradual replacement of callus by appropriate permanent

bone necessarily follow, bone in which no particle persists except it be in the line of constantly recurring stress and strain, but it will also necessarily follow that the position of every spicule of bone in the skeleton, cancellous or compact, is the expression of a physiological reaction to the forces of gravity and muscular tension.

The evolution of the machinery of the connective tissues seems to be not entirely the result of natural selection and the survival of individuals in which this machinery chanced to be of appropriate design. The appearance in early vertebrates of the material that is characteristic of the bone corpuscle seems to have ensured that skeletons would take a shape determined by the direction of the forces to which these corpuscles were exposed, and that the formation of this skeleton is as much a reaction to recurring stimuli as are the reflexes, composite movements and postures characteristic for the species.

This conception of the way in which the vertebrate connective tissues take their shape transfers a large share of the development of the bodily form back into the nervous system, in which the machinery is stored that directs and determines the habitual movements and postures that in reaction to external disturbances are specific. A physiological account of the evolution of the nervous system, one certainly that is based on the chemical constitution and chemical behaviour of its component parts, must seem almost infinitely remote from practical investigation. But the work of Pavlov has made one thing clear: that by a physiological reaction in it, machinery may come into existence which did not exist before. The repeated occurrence of a disturbance at times that are uniformly related to the normal operation of existing machinery results in the acquirement of a new reaction which must require machinery that is new. It is rendered probable, if not proved, that this new machinery is situated in what may be called the growing point of the central nervous system, the cortex of the cerebral hemispheres, the part where all is not 'cut and dry,' where cells retain more of the properties of the developing neuroblasts, the properties that enable them to grow out through the embryonic tissues along courses that make it certain that the maturing organism will behave in a manner true to type. In the formation of a conditioned reflex, two events are made to occur in the cerebral cortex at times which are uniformly related to one another; one of these events, from the constitution of the nervous system, necessarily results in a certain activity of some muscle or gland, the other has been hitherto in no way related to such a result; after many repetitions of the association of these events, it is found that that one which previously had never resulted in this particular activity, comes to have this result as certainly as the other.

But if and when it is possible to trace the origin of structures to functional reactions of cells, and to reactions that depend upon the chemical properties of the cell substance; and if and when this is possible not only in the connective tissues, but also in the nervous system, the functions of which have so controlling an influence on the operation of every part of the body; until it becomes clear that the results of changes in such influence reappear in succeeding generations, the study of functions can have no bearing upon the ultimate problem of biology, the evolutional history of life upon the earth. Pavlov communicated to the International Congress of Physiology in 1923 some results of experiments that he had done upon this subject which, when confirmed, should 'electrify the atmosphere.' Conditioned reflexes that are established only after many—eighty or a hundred—repetitions of the associated stimulus, in each succeeding generation require fewer and fewer repetitions, and in the fourth may be established after only four. In April of this year he wrote to say that owing to other work he had not been able to give the necessary time to confirmation of these results. We are content to wait.

In the great question whether characteristics developed in the life of an individual have any influence on descendants, experimental evidence must come slowly. In what is called parallel induction a step has been taken which is probably of greater importance than is generally conceded. External influences that affect the bodily characteristics of an organism affect also the germplasm in such a way that these characteristics appear in the first, and even, in a less degree, in the second generation born after the external influences have ceased to operate. While such experiments furnish evidence only of a temporary change in the properties of the germplasm, one that may be put down to the lodgment in it of unassimilated foreign matter that is gradually eliminated, the fact that the eternal germplasm has been shown to be subject to temporal influences must not be belittled. A true mutation is not eternal. Our descendants may be able to dispense with hæmoglobin. The hereditary melanism that in certain moths, it is said, can be induced by food infected with manganese, is, perhaps, something more than such parallel induction.

Physiological inquiry is a stream that has many sources; its waters gather from quarters far removed from one another. A marvellous meeting took place in the early years of this century when the forgotten experiments of Mendel came to the surface again, and found corroboration in the cytological studies that from about the same time had pursued their slow obstructed way above ground in the endeavour to elucidate the changes in the nucleus of maturing germ cells. In a resting germ cell the chromosomes form an even number, characteristic for the species; they consist of half that number of pairs of homologues, one of each pair descended from the paternal element in the last zygosis, the other from the maternal. At one of the cell divisions by which the germ cell gives rise to the mature gamete, with half the characteristic number of chromosomes, there occurs a segregation of the two members of each pair so that they pass into different gametes—the exact cytological equivalent of Mendelian segregation of allelomorphic pairs of characters. To-day the study of genetics and of the 'topographical anatomy of the chromosomes,' with its 'groupings' and 'crossings over,' seems to require chemical assistance. It may be that in the lifetime of some of us those confluent streams of thought and experiment are to be joined by yet another that rises in the vast, remote and, as it must appear to some, muddy swamps of physiological chemistry; and it then, forgetting its 'foiled, circuitous wanderings,' will form with them a 'majestic river, brimming and bright and large.'

Francis Bacon and Scientific Method.[1]

By Dr. C. D. BROAD.

II.

THE natural history, selected, arranged, and recorded by the rules described in the previous article, forms the basis on which scientific knowledge must be built. Bacon's next task was to construct a logical instrument by which a knowledge of general laws can be erected on this basis. Plainly the kind of reasoning which is needed is inductive. But Bacon objected both to the order and the form of reasoning which he found in current inductive arguments. Those who use them jump directly from particular facts to extremely sweeping generalisations, and they then deduce propositions of medium generality from these generalisations by means of syllogistic reasoning. Now Bacon's view is that there should be a very gradual ascent from particulars through principles of slowly increasing generality to the widest generalisations. Conversely, there should be a very gradual descent from the widest generalisations through principles of slowly decreasing generality to new particular facts. In the ascending scale each stage covers all the facts below it and extends very slightly beyond them. We then deduce observable, but not hitherto observed, consequences from the hypothesis and see whether they are true. If they are found to be so we can accept the hypothesis and go on to generalise it a little further. Thus the descending scale serves to test the stages in the ascending scale.

Bacon's objection to the form of reasoning employed in current induction was that it made no use of negative instances. It simply argued in the form: "All *observed* S's have been P, therefore *all* S's will be P." Now Bacon's view is that the cause of a given effect cannot be discovered by direct and positive means. It can be discovered only by gradually eliminating alternative possible causes until we are left with a single survivor, which can then be accepted with confidence as *the* cause. In order to discover the cause of a given kind of phenomenon, three sets of tables were to be formed, namely: (1) cases where this phenomenon is present; (2) cases where it is absent; (3) cases where it varies in degree. Now Bacon takes it as axiomatic that what he calls the 'formal cause' of a phenomenon is such that (1) it cannot be absent when the phenomenon is present; (2) it cannot be present when the phenomenon is absent; and (3) it cannot be constant when the phenomenon varies, or conversely. He knows then that the cause must be present in all the cases in the first table. He need not consider, therefore, any factor which is absent from any of these cases. Again, he need not consider any factor that is present in the cases in the second table, for the cause must be absent from all of them. Lastly, he can reject any factor which is constant throughout the cases in the third table. By this method of rejection, and by it alone, Bacon thought it possible to discover with certainty the causes of given effects.

This is Bacon's method in the barest outline. What kind of fact did he hope to discover by it? He tells us that the ultimate aim of theoretical science is to discover 'the forms (or formal causes) of simple natures,' and that the ultimate aim of applied science is to use this knowledge to 'induce on bodies the form of any nature that we may desire it to have.' He draws a sharp distinction between the 'formal cause,' on one hand, and the 'material' and 'efficient' cause, on the other. He assigns the study of material and efficient cause to 'Physics,' and their practical use to 'Mechanics'; whilst he assigns the study of formal causes to 'Metaphysics,' and their practical employment to what he calls 'Natural Magic.' But he recognises that he is here using 'Metaphysics' in an unusual sense. The meaning of all this is the following. By a 'simple nature' Bacon means some perceptible generic physical property, such as colour, temperature, etc. By the 'form' or 'formal cause' of a simple nature he means that which this property is in things themselves apart from their relation to sensitive organisms. Thus, violent and irregular molecular motion would be the 'form' of the 'simple nature' called 'temperature.' Again, periodic variation of electro-magnetic intensity would be the 'form' of the 'simple nature' called 'colour'; and so on. So the Metaphysics of Forms is what we should call Microscopic Theoretical Physics. The propositions of 'Physics,' in Bacon's sense of the word, are what we should call 'empirical laws,' *e.g.* 'if amber be rubbed with flannel it becomes electrified.' Here the 'material cause' is amber and flannel, whilst the 'efficient cause' is the process of rubbing the two together.

Now of course we may know of various practical methods of inducing heat or electricity on bodies when we know nothing of the form of heat or the form of electricity But Bacon sees that so long as we have merely this rule-of-thumb kind of knowledge our practical control over Nature will be very limited. If, on the other hand, we know the form of a given nature we know that *any* means of inducing this form will induce this nature, and that nothing else will do so. Thus by knowledge of forms, and by that alone, we may be able to produce profound modifications at will in the properties of bodies. This is what Bacon means by 'Natural Magic'; and the syntheses of new substances in organic chemistry would be an example of what he had in mind.

Bacon holds that there is a part of physics and mechanics which is closely connected with metaphysics and natural magic, and constitutes the transition from the former to the latter. This he calls the study of the 'Latent Structure' and the 'Latent Processes' of bodies. He recognises that bodies have an inner microscopic structure too small for our unaided senses to perceive, and that many of their perceptible characteristics depend upon this. He also recognises that what we call the efficient causes of given effects are only isolated outstanding features in processes which are continuous and in the main imperceptible. If we are to understand and control Nature we must turn our attention from the gross structure and changes of bodies to their minute components and processes. Bacon particularly insists that, whilst both of these

[1] Continued from p. 488.

subjects have been neglected, the latter has been more neglected than the former; and yet the dynamical aspect of Nature is even more important than its statical aspect.

It will be interesting at this point to consider Bacon's views about mathematics, for they exhibit his peculiar weakness and strength in a clear light. It is evident that Bacon was no mathematician. He has no theory of mathematical reasoning; he seems to be contemptuous of pure mathematics; and he was evidently unacquainted with the progress which was being made by both pure and applied mathematics in his time. It is noteworthy that in his remarks about Plato, with whom he is not altogether unsympathetic, he never thinks of Plato and his school as mathematicians but always as theologians and moralists. Yet Bacon does repeatedly say that physics cannot progress far without mathematics; and some of his strictures on the excessive worship of mathematics in science are the negative side of an important positive demand. Thus he complains that optics and astronomy have fallen wholly into the hands of mathematicians. When this complaint is investigated it is found to mean that Bacon wants something more than mere geometrical optics and mere descriptions of the courses of the heavenly bodies. He wants a *physical* optics and a *physical* atronomy, which shall deal with the *nature* of light and the *substance* of the stars and planets. His own attempts to supply this want are of very little value, but the demand is a sound one.

Although Bacon held that the proper course for scientific reasoning to take is a gradual ascent from particulars to general laws and a gradual descent from these general laws to new particulars, he was prepared to admit as a subsidiary process the direct passage from one particular to other partly analogous particulars. This he calls *Instructed Experience* (*Experientia Litterata*). He distinguishes various forms of this, of which the following are the most interesting: (1) Varying an old experiment, either by applying it to different but partly analogous materials, or by applying different but partly analogous processes to the old materials, or by varying the quantities or intensities of the factors in the old experiment. (2) Repeating the original process on the product of the previous experiment, as in redistillation. Bacon is careful to point out that we must never assume that an increase in any factor will produce a corresponding increase in the effect, or that the repetition of a process upon its product will increase the effect. (3) Extending a process from Nature to art, from one art to another, or from one part of an art to another part of it. Bacon says that new and useful processes are most likely to be discovered when one or a few men learn to compare the processes of a number of different mechanical arts. (4) Inverting one or more of the factors in an experiment; *e.g.* substituting great cold for great heat. (5) Making one factor gradually more or less intense until the characteristic effect just ceases to take place. (6) Coupling together two cause-factors, each of which has already been tried separately. Here again Bacon carefully points out that we have no right to assume that, because a in the absence of b gives α, and b in the absence of a gives β, therefore ab will give $\alpha\beta$. We may conclude this point of Bacon's doctrine with two highly characteristic quotations: "Though a successful experiment be more agreeable, an unsuccessful one is often no less instructive"; and "Experiments of Light" (*i.e.* those which throw light on the laws of Nature) "are more to be sought after than Experiments of Fruit" (*i.e.* those which lead to results that are of immediate practical use).

I will conclude by mentioning the seven cases in which the senses have to be aided and the kind of help which Bacon suggests. (1) If the object be very distant it must be joined to something which is perceptible at a distance, *e.g.* something that gives a flash or a noise. (2) If it be enclosed in an opaque envelope it must be judged by processes at the surface (*e.g.* feeling the pulse) or by what comes out from it (*e.g.* examination of urine). (3) It may be unable to affect the senses because of its intrinsic nature (*e.g.* colourless gases), or (4) because of its minuteness. The latter difficulty can be avoided by causing it to produce some effect of sensible magnitude (*e.g.* using an air-thermometer to indicate small changes of temperature). (5) Motion may be too slow or too swift to be perceived. In the former case it can be magnified by pointers and similar devices. Bacon does not know how to deal with the latter case. (6) The intensity may be too great for the senses to bear. In this case Bacon recommends the use of reflectors or semi-opaque screens. (7) The senses may be very rapidly exhausted. This happens only with taste and smell. Bacon suggests no remedy for this; but he says that where our senses fail us altogether we may use those of animals (*e.g.* dogs for scent).

Much of the merit of Bacon consists in minute detail, and is lost in a rapid sketch like the present. I think we may sum up his strength and weakness as follows. He was not a great scientist, either practically or theoretically. But he saw many of the essential factors in successful scientific procedure with great clearness, and stated them with admirable force. His method is admittedly incomplete; and no method could accomplish all that he expected of it. The nearest approach to a complete method would be a synthesis of the methods of Bacon and Descartes. But we must go far before we shall find another such combination of wide generalisation, strong common sense, balanced enthusiasm, and pointed eloquence as we find in Bacon.

The Tropical Cyclone.

By E. V. NEWNHAM.

THE cyclone season of the northern tropics is drawing to a close. The accounts of widespread damage to property and loss of life, both in the Gulf of Mexico and in the Far East, that have appeared recently in the newspapers, show that the storms that have already occurred will make this season a memorable one. It is not intended here to deal with these recent events, but rather to present the salient facts about the tropical cyclones of both hemispheres, and to indicate the extent to which these phenomena are understood at the present time.

Like all meteorological phenomena, tropical cyclones

show great individual variations from the general type; nevertheless, their general characteristics are sharply defined. In size they occupy an intermediate position between the two other kinds of atmospheric vortex that give rise to winds of hurricane strength, namely, the large cyclonic depression of temperate and high latitudes and the small but excessively violent tornado of the American and Australian type. In all three vortices the pressure of the air is greatly reduced towards the centre, but it is only in the case of the tornado that the pressure becomes too low to be recorded by the ordinary barometer.

The typical tropical cyclone consists of a nearly circular symmetrical whirl, clockwise in the southern hemisphere, counter-clockwise in the northern hemisphere, with a diameter varying from 100 to 600 miles, about a central 'eye,' where the air is nearly calm. The wind is strongest along the margin of the 'eye,' which averages about 14 miles in diameter, and in this region often greatly exceeds a hundred miles an hour. Within the 'eye' the weather is usually fair, but in the zone of strong winds torrential rains occur. The movements of the clouds are in general centrifugal, particularly as regards the higher clouds. The place of origin is in general over the hotter parts of the ocean between latitudes 8° and 12° on both sides of the equator, generally near the equatorial margin of the trade winds bordering the doldrums, or belt of equatorial calms and light winds, but in the case of the storms in the Bay of Bengal and the Arabian Sea, in the region of variable winds and squalls that occur at the transitions between the north-east monsoon of the winter and the south-west monsoon of the summer.

Tropical cyclones form in three zones:

(1) The south-western part of the North Atlantic, around the West Indies.

(2) From the Arabian Sea eastwards so far as the China Seas and western part of the North Pacific.

(3) From around Madagascar eastwards to the Paumotu Islands.

There is, as a rule, one definite season extending over several months and reaching a maximum a little before the autumn equinox, when the ocean is generally at its warmest. Individual seasons differ greatly as regards the number and intensity of the storms that occur, and a connexion has been claimed by some writers between the character of the season and the number and size of the spots on the sun, but a clear relationship for the whole area affected by cyclones has not been established so far.

Cyclones move slowly along paths which also show great variation, but a dominant tendency towards motion along a certain type of curved path, sometimes described as parabolic or hyperbolic, is apparent in all parts of the world where a large mass of land is not so situated as to prevent the storm from passing through its normal life-history.[1] The motion during the first few days is compounded of an east to west drift, and a slight poleward drift, but somewhere between latitudes 20° and 30° (north or south) the motion becomes directly poleward and then inclines towards the east, becoming north-easterly on leaving the northern tropics and south-easterly on leaving the southern tropics. It should be noted that within the tropics the movement is clearly not in accordance with the prevailing winds of the region through which the storm is passing, and is more often than not almost directly opposed to those winds,[2] but on leaving the tropics, when the storm begins to lose its tropical characteristics and take on those of the ordinary temperate 'depression,' the motion, in the case of the cyclones of the North Atlantic and the China Seas, appears as a rule to be that of the prevailing winds, between about latitudes 30° and 50° N.

To return to the important subject of their place and time of origin: whatever the process may be whereby a cyclone begins to form in a region of light and variable winds, there can be little doubt that their whirling motion is due to the deflective force of the earth's rotation. Now this force varies as the sine of the latitude, and is therefore inappreciable for some degrees north and south of the equator; this fact explains why cyclones seldom originate within 8° of the equator. The reason why the time of maximum frequency is normally just before the autumn equinox appears to be that one of the necessary conditions for the formation of a cyclone is a discontinuity between distinct wind systems, and this will be found at a suitable distance from the equator when the equatorial belt of calms (the doldrums) is nearly at its farthest from the equator, *i.e.* not long after the summer solstice, the maximum being retarded somewhat because the greatest warmth of the ocean is normally attained about two months after the solstice. In the case of the Indian cyclones there is a double maximum, one in early summer and the other in autumn; in this case, the controlling factor is clearly the presence or absence of the necessary discontinuity of wind, the warmth of the sea appearing to play little part in fixing the cyclone season.

The above general description of tropical cyclones is based mainly upon a recent memoir of the British Meteorological Office,[3] which is in turn based upon all available contributions to the literature of the subject up to 1920. In the introduction to this work, Sir Napier Shaw attempts to explain the life-history of a tropical cyclone from its birth, as a result of the convection in suitable circumstances of hot moist air, to its death, when, having been transformed into a cyclonic depression of temperate latitudes, it is surrounded by cold dry air on reaching the polar regions. The convectional stage is developed in a very ingenious manner: a number of small convectional 'bubbles' are assumed to unite into a single large 'bubble'; air is withdrawn over a certain area and is 'evicted' in the upper atmosphere; the system quickly acquires the properties of a fully developed cyclone and begins to drift towards the west. In a theoretical section, Dr. H. Jeffreys, regards a combination of the two principal theories so far advanced to explain the origin of cyclones—the 'millpond eddy' and the

[1] The storms of the Bay of Bengal and Arabian Sea appear to behave normally in this respect, but the great land mass to the north does not allow them to survive long enough to follow more than the first third or half of the typical path

[2] So far as I am aware, this point has not been emphasised hitherto. Its truth rests upon the accuracy of the charts of prevailing wind published in "Bartholomew's Physical Atlas," vol. 3, plate 14, which are due mainly to Koppen.

[3] "Hurricanes and Tropical Revolving Storms" By Mrs. E. V. Newnham. Meteorological Office Memoir, No. 19, 1922.

'convectional' theories—as necessary for a complete explanation.

Since 1920 several further contributions have been made to the literature of tropical cyclones. One deals with the region around the West Indies.[4] Redrawing the tracks of all known cyclones in this area since 1886, Mitchell found that no storm originated over the eastern two-thirds of the Caribbean Sea; many storms originated, however, south of the Cape Verde Islands, and some over the western third of the Caribbean Sea. The deciding factor in this case, as for the Indian cyclones, appears to be the presence or absence of a discontinuity between conflicting winds; such a discontinuity is absent over the eastern two-thirds of the Caribbean Sea. Another interesting fact pointed out by Mitchell is that the cyclone of this area 'recurves' (*i.e.* turns directly polewards) as soon as a trough of low pressure arrives to the north, irrespective of the longitude and time of year.

Another recent valuable publication deals statistically with the tropical cyclones of Australia, without, however, contributing much that is new to the theory of the storms.[5] The last paper to which I shall refer is concerned with the dynamics of the formation of cyclones.[6] Capt. Brunt follows Shaw in regarding simple thermal convection of moist air as the initial stage, the energy for the subsequent violent winds being supplied by the latent heat of condensation of the water vapour that is precipitated in the rising column of air before those winds arise. He lays stress on the importance of explaining how the removal of air from the centre of a developing storm is brought about, and presumes that it is effected by the discharge of the column of rising air into strong upper winds.

The verification or refutation of this and of the various alternative theories of the origin of cyclones that have been brought forward, which space does not permit me to describe, awaits a more complete knowledge of the temperature, humidity, and wind at all levels in the regions of formation of cyclones, which are unfortunately in most cases just where observations of any kind are most difficult to obtain.

[4] "West Indian Hurricanes and other Tropical Cyclones of the North Atlantic Ocean." By C. L. Mitchell. *Monthly Weather Review* Supplement No. 24, 1924.

[5] "Australian Hurricanes and Related Storms." By S. Visher and D. Hodge, 1925.

[6] "The Origin of Tropical Revolving Storms." By D. Brunt, London Meteorological Office. *Marine Observer*, 1924.

The Reported Conversion of Hydrogen into Helium.

THE current (September) issue of the *Berichte* of the German Chemical Society contains a paper by Profs. F. Paneth and K. Peters on "The Transformation of Hydrogen into Helium," in which they describe in outline how they have succeeded in detecting the presence of very minute amounts of helium, of the order of one hundred millionth of a cubic centimetre, derived from hydrogen which had been absorbed by finely divided palladium at the ordinary temperature.

Theory indicating that this conversion would involve the liberation of much energy ($6{\cdot}4 \times 10^{11}$ cal. from 4 gram-atoms of hydrogen), the author's primary task was to find out if the change would take place without introducing energy from outside, *e.g.* in the presence of a catalyst; and in order to be able to detect very small quantities of helium they elaborated the spectroscopic method in such a way that the limiting amount detectable was 10^{-8}-10^{-9} c.c., or 10^{-12}-10^{-13} gm. Easily liquefiable gas was removed with liquid air and charcoal; oxygen was added and the hydrogen burnt on the surface of the catalyst; water-vapour and excess oxygen were removed with charcoal, and the residual gas was passed into a glass capillary-tube of 0·1 mm. section, which was surrounded with electrode-wires and placed before the slit of the spectroscope. Every precaution was taken to exclude atmospheric helium; the portion of the apparatus that was heated was surrounded with a vacuum-mantle and immersed in water. The presence of neon lines afforded a most valuable criterion of the presence of atmospheric gases; neon was never completely excluded, but the amount present was so small that it did not invalidate the author's main conclusion.

The method is so delicate that the liberation of helium from a mixture of thorium B and thorium C was easily detected, while it is sufficiently sensitive to determine the presence of helium in a few cubic centimetres of natural gas. By its means a natural gas containing 0·19 per cent. by volume of helium was discovered in Germany, and steps have been taken to exploit it commercially. The Canadian natural gas from which helium is extracted contains 0·33 per cent. by volume.

Attempts were made to effect the transformation by submitting hydrogen to the action of a silent electric discharge in an ozone apparatus, and by passing a prolonged and powerful discharge through it in a Geissler-tube fitted with aluminium electrodes; but no success was achieved. Nor was the attempt to produce helium by bombarding certain salts with cathode rays, as suggested by Lord Rayleigh, any more fertile, so that recourse was had to passing fairly large amounts of hydrogen—up to one litre—through heated palladium, in the hope that at the moment of exit a fraction of the protons and electrons would combine to form the helium nucleus. In this case the indications were favourable, but the result was inconclusive owing to the presence of atmospheric neon, and the absence of any proportionality between the strength of the helium lines and the amount of hydrogen that was used.

Finely-divided palladium, either as sponge, 'black,' or palladinised asbestos, was then used to absorb hydrogen at room temperature, and after different intervals of time the hydrogen was combined with oxygen, as previously described. The residual gas obtained after a 12-hours' contact between palladium and hydrogen exhibited four or five lines of the helium spectrum and only a single neon-line; there was also a distinct proportionality between the amount of helium observed and the duration of the time of contact. The activity of the different palladium preparations employed varied considerably; it invariably diminished with repeated use, but both the power of absorbing hydrogen and of effecting the transformation were restored by heating in hydrogen or oxygen, in a mixture

of these gases, or in a vacuum. No helium production was observed with palladium preparations that did not absorb hydrogen, although preparations were occasionally obtained that absorbed hydrogen well but gave little or no helium, especially if the hydrogen had been absorbed at a high temperature.

The above results indicated that palladium preparations that have long remained unused at room temperature should contain a little helium (not of atmospheric origin). Examination of a number of such specimens showed that helium was present in all of them, and in particular a specimen of palladinised asbestos, which had been purchased from Kahlbaum two years previously, was found to be relatively very rich, 1 gm. of it containing 10^{-6} c.c. of practically pure helium. After this specimen had been heated to expel the helium, and treated with oxygen for twelve hours, no fresh helium was detected, but at the end of five hours in contact with hydrogen a considerable amount of helium was found. This experiment was performed three times with the same result. The palladium, however, gradually lost its activity; at the beginning it produced helium at the rate of 10^{-8}-10^{-7} c.c. per day; after twenty treatments it became inactive. Its activity was restored, although not to the original degree, in the manner described above. Finely divided platinum is less active than palladium, and the action of pyrophoric nickel is weaker still.

The authors discuss fully the possible sources of error in their experiments, such as the ingress of atmospheric helium, the adsorptive capacity of glass for helium, the conceivable preferential adsorption of helium by palladium, or by asbestos, and the possibility of helium being formed as a radio-active disintegration product of palladium; all of which they consider to be excluded. The hydrogen and oxygen used by them contained less than 0·001 per cent. of air. They were not able to detect any trace of the energy liberated during the transformation, and they point out that the amount set free from the conversion of such small quantities of hydrogen—about 0·28 calorie—would be extremely difficult to detect, and particularly so if thermal changes due to absorption or formation of compounds also take place. They incline to the view that the liberated energy is more likely to appear as radiation, *e.g.* as γ or Millikan-rays, than as heat.

News and Views.

ONE of the subjects discussed at the recent World Power Conference at Basle was the exchange of electrical energy between countries. An interesting example of this interchange of energy occurs between Denmark and Sweden. Submarine cables crossing the Sund Straits transmit power at 25,000 volts and 50,000 volts respectively. When the water supply in Sweden is abundant they carry the excess hydroelectric power to Denmark, and when Sweden suffers from water shortage they convey thermally generated power in the reverse direction. It was pointed out that some countries, Switzerland for example, have great water power resources but yet are very unwilling to export electric power, and set up high tariffs. One of the reasons for their action would appear to be that, in the opinion of some Swiss engineers, Switzerland is destined to become one of the important centres for carrying out electrometallurgical and electrochemical processes on a large scale. In their opinion, the sale of electrical energy abroad helps the establishment of those industries outside their own frontiers and so is not in the national interest. Another objection is that the export of electricity in bulk to foreign countries will gradually subordinate Switzerland to these countries; the foreign capital introduced being conceivably a source of danger. Mr. Niesz of Baden held that these objections have no real foundation. The majority of the engineers present agreed that it is desirable that the authorities in different countries should place no obstacle in the way of a free interchange of electrical energy provided that economic conditions are favourable.

MR. ALAN COBHAM alighted on the Thames opposite the Houses of Parliament on October 1, thus completing his latest flying achievement. In recognition of his services to aviation the King has conferred upon Mr. Cobham the honour of knighthood (K.B.E.). His three long-distance flights are a notable advertisement for commercial aviation. The De Havilland-50 aeroplane, with Armstrong-Siddely "Puma" engine and interchangeable floats and wheels, was designed for flying in countries with undeveloped transport services, where lake, river, or sea offer natural alighting places. An aeroplane of this type was flown to Rangoon and back. The same aeroplane fitted with the more powerful "Jaguar" engine was flown to the Cape and back. Finally, the same aeroplane and engine, after overhaul and fitting of forged "Y-metal" aluminium pistons, was flown to Melbourne and back, floats being fitted as far as Port Darwin, wheels for trans-Australian flying. The structural alterations required for the heavier engine, if any, are not known, but the following are some of the main characteristics:

D.H.-50.	Puma Engine.	Jaguar (Radial) Engine.
Span, 13 m.	6 cyl. (water cooled)	14 cyl. (air cooled).
Surface, 41 m².	180 kw.	290 kw.
Total wgt., 1770 kgm.	1400 r.p.m.	1700 r.p.m.
Speed, 180 km./hr.	300 kgm. wgt.	360 kgm. wgt.

The last of the three flights was equivalent to flying 800 km. every other day from June 30 to October 1, a high feat of personal skill and endurance, and an equally remarkable record of aeroplane and engine performance.

THE specificity of quinine in curing or relieving the symptoms of malaria has long been known. At the present time, the chief drawback to its use is its cost, due in part to the few areas in which the bark yielding the highest proportion of this alkaloid can be cultivated and in part to the restriction of output. Other drugs have therefore been tried in the treatment of this disease; the other crystalline alkaloids present in the more common variety of bark, quinidine, cinchonine, and possibly cinchonidine, have been

shown by Fletcher to be nearly as efficacious as quinine itself (see *Brit. Med. Journ.*, 1926, vol. i. p. 154), and their use therefore should result in a considerable reduction in the cost of treatment. On the other hand, no synthetically prepared compound has so far been found to be of value, but this statement may soon be no longer true if the report from Germany which appeared in the *Times* of September 25 is confirmed. The new drug is called 'Plasmochin,' and has been tested both experimentally in birds and animals and also clinically of endemic malaria and in cases of general paralysis of the insane who have been submitted to the malarial treatment. This treatment consists in infecting the patient with one form of the malarial parasite, and after a week or two curing him with quinine; great improvement of the original symptoms has resulted in many cases. The drug appears to be non-toxic, but caution is expressed as to whether it will replace quinine completely in the treatment of malaria. It has, however, been found to destroy the crescent forms of the 'malignant' tertian parasite within five to seven days. It is possible that it may form a useful adjunct to treatment with quinine or the other cinchona alkaloids.

MR. G. N. HUMPHREYS, of the Uganda Survey Department, has recently led two expeditions to Ruwenzori; he has climbed most of the chief peaks, and made an extensive examination of the range. His first expedition in February of this year was hampered by bad weather, but he climbed Mount Speke and the peak Vittorio Emanuele, and an unnamed peak; and the expedition achieved the first crossing of the range from east to west, it used a pass near Mount Gessi, and discovered three new lakes, of which the largest is two miles long. The second expedition in July had better weather, and the party climbed both the peaks Margherita and Alexandra on Mount Stanley, some of the higher peaks on Mount Baker, and Mount Luigi di Savoia. The expeditions made some natural history collections A preliminary account of the journeys was given by Mr. Humphreys in a lecture to the Uganda Literary and Scientific Society on August 27 last.

THE British Aquarists' Association has just held its first exhibition in the British Sea Anglers' rooms in Fetter Lane, London, E.C. 4. Judging by the exhibits alone, one would gather that the primary object of the Association is the study of the elegant and comfortable management of freshwater vertebrates, and the provision of expert advice to its members on the construction and maintenance of aquaria. A glance through the *Amateur Aquarist and Reptilian Review*, the official organ of the Association, however, shows that it has much wider biological interests in the structure, habits and life-histories of aquatic organisms generally. In a first exhibition, it was natural that the goldfish family and the quainter and more ornamental water vertebrates should predominate, and we were surprised to find four healthy specimens of such a rarity as Proteus in one aquarium. The exhibition gave special attention to the problem of the respiratory balance. The mechanical method was represented by a recurrent siphon fountain of simple make, an aerating cylinder in which a pump is used to develop air-pressure sufficient for twelve hours' aeration, and a fish aquarium with a sluice under the perforated floor which flushes away the accumulated débris without disturbing the water above. Biologists who prefer the plant-animal balance would be interested to find that such a large variety of aquatic plants from all over the world can now be purchased from dealers in London. The experience of the Association should prove of value to biologists intending to do experimental work with living aquatic animals.

THE work of the Building Research Station of the Industrial Research Department is described in a ten-page pamphlet issued by H.M. Stationery Office. Originally housed in temporary buildings at Acton, this station has now been transferred to permanent quarters at Garston, near Watford, which change admits of considerably increased activities. The highly technical problems involved in modern building are often insufficiently appreciated These problems refer not only to the purely engineering, constructional, and accessories features contained in most large buildings but also embrace developments in the use of, and a scientific knowledge of, the materials which are popularly associated with ordinary building. To elucidate these matters, the co-operation of the chemist, physicist, architect, and engineer is necessary. As is pointed out, quite apart from the general claims of this industry to a share in the efforts of the scientific worker, the country is involved in huge sums spent upon housing, and it is in the national interest that every effort should be made to utilise science in the interests of real economy in construction. By arrangement with other institutions, the station carries out special researches in addition to the work within its own walls, and is prepared to deal with problems for private individuals at arranged fees. Included in the scope of its work is the collection and co-ordination of current results of investigation from other sources.

DURING the week-end September 24-27, the third conference of the Association of Special Libraries and Information Bureaux was held at Balliol College, Oxford. The immediate object of the Association is the preparation of a directory which, with suitable classification, will direct attention to the sources where special collections of books or other materials have been brought together, whether these be in public libraries or in private collections. This task is a large one, and it is being assisted by a grant of 2000*l.* from the Carnegie United Kingdom Trust. Information bureaux are now being rapidly founded in connexion with many industrial and commercial enterprises, and several of the papers and discussions at the conference dealt with these developments. Papers dealing with the collection of technical information and its utilisation by research associations for the benefit of manufacturers in different branches of industry were also read. The Association is keeping in close touch with foreign sources of information,

and is securing liaison with similar developments abroad. At the conference, Dr. de Vos Van Steenjiwk gave an account of the work of the new International Institute of Intellectual Co-operation at Paris. The Association, in preparing the directory and acting as a clearing-house for sources of information, is rapidly placing itself in a unique position to offer valuable service, which will doubtless attract a large membership from professional and business circles. Further information on the Association's work can be obtained from its office at 38 Bloomsbury Square, W.C.1.

DR. D. G. HOGARTH in "The Twilight of History," a lecture delivered as the eighth Earl Grey Memorial Lecture at Armstrong College, Newcastle, in February last, and now published by the Oxford University Press, suggests a new orientation in approach to the problems of the obscure period between the downfall of the second Late Minoan kingdom in Crete and the rise of Hellenism. He does not regard the decadence in art which is to be observed in this period as necessarily implying a set-back in civilisation. While he would agree with the late Sir William Ridgeway in the view that Minos was not 'Minoan' at all, and did not participate in the civilisation named after him, he would not concur in calling him the 'destroyer.' Neither the Achæan nor the Dorian invasion, on his view, was catastrophic. He argues that pre-eminence in artistic products is an accompaniment of an aristocratic regime based upon a subject population of inferior culture, whereas the decadence in artistic motives which follows Late Minoan II, being accompanied by improved technique, for example in pottery, points to the substitution of the artisan for the artist, and a wider diffusion of culture among the people at large. The wider distribution of Minoan products indicates a period of expansion rather than dispersal and the development of an export trade which brought the Greek world into contact with the fertilising influence of the Oriental. Dr. Hogarth concurs in the view that the break up of the Mycenæn Empire was due to the Dorians, but so far from regarding this as the beginning of a 'Dark Age,' he looks upon the isolated communities under hereditary nobles which they founded as the precedent condition of the evolution of the Greek city state. A brief summary does less than justice to Dr. Hogarth's sanity of outlook and his sense of proportion. A careful study of his stimulating lecture might perhaps serve to curb some of the wilder flights of enthusiasm which, apparently, fail to surmount a wall erected somewhere about 776 B.C.

IN connexion with the opening of the reorganised public exhibition galleries of the Imperial Institute, Mr. Arthur M. Samuel, Parliamentary Secretary of the Department of Overseas Trade, addressed a well-attended meeting of head teachers of schools in the London area, held in the great hall of the University of London on the evening of September 28. The Hon. W. G. A. Ormsby-Gore, Under-Secretary for the Colonies, and the Duchess of Atholl, Parliamentary Secretary to the Board of Education, also addressed the teachers. The galleries were opened to the public on the following day. The present system of arrangement, which has been introduced by the new director of the Institute, Lieut.-General Sir William Furse, has as its main object the development of the educational value of the collections, which are planned to illustrate as completely as possible the economic and physical geography of the overseas countries of the Empire. The plan of arrangement which has been adopted for the courts is in keeping with modern ideas in regard to the teaching of geography. Maps and models in relief illustrate the topography and configuration of the country, the distribution of rainfall and other important features. Wherever possible or appropriate, space is devoted to exhibits illustrating the ethnology of the country, and the visitor then passes to a series of show cases in which are displayed selected natural products and manufactures of the country, particular attention being given to new products and developing industries. Complete series of samples for inspection by commercial men and others are to be arranged in special sample rooms. Exhibits illustrating the opportunities for sport are also a feature in certain courts. Full use has been made of the experience gained at the British Empire Exhibition in developing effective means of display, a notable example being the installation of a striking series of finely executed dioramas which portray scenery and natural features, industries, and sport. The scheme has not yet reached its full development in all the courts, but it is clear that the reorganised galleries should prove of great value for teaching purposes and at the same time offer a most attractive display to the general public

THE *Empire Cotton Growing Review*, vol. 3, No. 3, July 1926, continues to publish interesting accounts of the possibilities of cotton-growing in various tropical dependencies overseas Mr. G. F. Keatinge, revisiting South Africa in 1925, finds that the production of 1000 bales in 1919, is now 10,000, but would have been more but that many farmers have been discouraged as the result of drought in 1924, excessive rain in 1925, and insect pests at all times. Where, however, cotton is grown continuously on the same land for a series of years, a slow accumulation of pests is to be expected. Cotton prospects in Papua and in New Guinea are discussed by Mr. G. Evans. This number of the journal contains the second part of an article of more general interest to agriculturists, in which Messrs. F. L. Engledow and G. Udny Yule discuss the principles and practice of yield trials. This discussion, which deals with the many difficulties of such yield trials in a critical and yet practical spirit, will be of very general value; the authors state that the form of their paper is the result of their experience in training six generations of 'cotton men' at the School of Agriculture, Cambridge. The Empire Cotton Growing Corporation has also published separately a very full report by Col. C. N. French upon cotton-growing in Nigeria, which is a very interesting discussion of the problems of cultivation, transport, and marketing which arise in a territory where cotton is grown by native farmers.

The report is a striking tribute to the work of the Director of Agriculture, Mr. Faulkner, and his staff.

WE have received a copy of No. 2 of *Continental Metallurgical and Chemical Engineering*, a publication in English, issued by the Dr. Joachim Stern Verlag in Berlin. This periodical is devoted to metallurgical and chemical subjects, and the number received, which is that for September, contains the first part of an article on the cutting and turning of metals, describing important experiments now in progress in the Technische Hochschule of Berlin with the object of determining the forces in action at the cutting edge of the tool and the mechanism of the cutting process. Another subject which is treated in detail is the extraction of radium, vanadium, and uranium from carnotite, whilst the manufacture of ruby glass and the production of synthetic camphor are also topics which receive notice. The review of current literature is, in this number, confined to chemical and metallurgical papers from French and German periodicals On the commercial aspect, the most interesting article is one describing the movement for the formation of a continental iron and steel syndicate, containing an account of the steps which have been taken in this direction in various European countries, mainly with the object of countering the efforts of the great American steel-marketing organisations. The new periodical is associated with the *Metallborse*.

THE issue of the *Physikalische Zeitschrift* for July 15 contains a portrait of the late Prof. Otto Lummer and an account of his life and work from the pen of Prof. E. Riecke. Otto Lummer was born in Gera on July 17, 1860, studied mathematics and physics at the Universities of Tübingen and Berlin, obtained the degree of doctor at the latter in 1884 and acted as assistant to Helmholtz at the University until 1887, when he followed his chief to the newly established Reichsanstalt at Charlottenburg. He lectured at Berlin from 1901 until 1904, when he became professor of physics at the University of Breslau He died suddenly on July 5, 1925 Throughout his life he was a skilled experimenter and an attractive lecturer. The work for which he is best known was done while at the Reichsanstalt—the invention of the Lummer-Brodhun photometer in 1889 and the Lummer plate in 1902, the accurate measurement of the ratio of the specific heats of gases with Pringsheim in 1887–1898, and the measurement of the emission spectrum of a black body also with Pringsheim in 1899–1900, which furnished Planck with the starting-point for the quantum theory. His work while at Breslau was concerned mainly with photometry and its industrial applications.

THE annual report of the Field Museum of Natural History, Chicago, for 1925 contains, as usual, much to make museum workers in Great Britain think. Take, for example, the expeditions during the year: there were three making archæological collections—in Mesopotamia, Egypt, and Peru; two making ethnological collections—in the neighbouring states and in Madagascar; three dealt with various branches of botany—in Peru, Chile, and British Guiana; one sought for fossil vertebrates in Argentina; the Roosevelts led a general zoological expedition through the high lands of central Asia; and four other zoological expeditions worked in Central Africa, Southern Georgia, Saskatchewan and Alberta, and British Columbia. Out of the 21 collectors thus engaged eight were members of the ordinary scientific staff, very nearly one-third of the whole. What one ponders over is how the staff manages to deal with the mass of material that is pouring in. That it does deal with some of it in a highly successful manner is clear from the photogravure plates of various exhibits, such as the man-eating lions of Tsavo and the reproduction of a flowering cactus from British Guiana. These plates, it should be mentioned, are all produced in the museum, and are but one example of its unusual activities. Many solutions of our problem suggest themselves, but one seems certain: the museum must employ many highly-skilled technical assistants. We should like to see a complete establishment list, with the rates of pay.

THE Royal Meteorological Society has lately issued the first three numbers of a new series of publications, entitled *Memoirs*, in which it is intended to include the more technical papers printed by the Society. Such papers have hitherto appeared in the *Quarterly Journal* of the Society, which is circulated to all the fellows, but with the recent growth in the mathematical and technical developments of meteorology, this course has been judged less suitable than the new plan now adopted. The *Quarterly Journal* is intended to make a wide general appeal to those interested in meteorology, and will continue to include a large number of the papers submitted to the Society, together with other meteorological notes and articles: but the more technical and difficult papers, which, for reasons of economy, will be sent only to those fellows who indicate their special interest in these papers and express a desire to receive them, will be noticed in the *Quarterly Journal* only by title or in abstract. The Society, like most other publishing scientific societies, finds the financial difficulties due to increased cost of printing enhanced by the growth in the number of papers presented to it, and this new departure is rendered possible only by the aid of a share of the recently increased Government grant for scientific publications, administered by the Royal Society.

ORDERS of the Committee of Privy Council have been issued by which Dr. Charles J. Martin, Director of the Lister Institute and professor of experimental pathology in the University of London, and Sir Frederick G. Hopkins, professor of bio-chemistry in the University of Cambridge, are appointed members of the Medical Research Council into the vacancies caused respectively by the death of Lieutenant-General Sir William B. Leishman and by the retirement of Prof. T. R. Elliott.

MR. W. R. THOMSON, formerly a member of the staff of the Royal Agricultural College, Cirencester, has been appointed by Messrs. Fertilisers Sales, Ltd., Adelaide House, King William Street, London, E.C.4, to be director of propaganda for calcium cyanamide in Ceylon.

THE Chemical Society is publishing a series of photographs of eminent chemists, reproduced by a photo-lithographic process. So far eight are available: Bunsen, Emil Fischer, Hofmann, Mendeléeff, Pasteur, Sir William Perkin, Ramsay, and Roscoe. The portraits should be admirable and inspiring decorations for chemical and other laboratories.

FROM the fifty-sixth annual report of the Newport (Mon.) Public Libraries, Museum, and Art Gallery, for 1925–26, we learn that a new building for the Museum and Art Gallery is as urgently needed and as far off as ever. Meanwhile valuable objects of art and science, which should find a home in Newport, are directed elsewhere, and the educational activities of the Museum are hampered for want of a lecture room

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A medical practitioner as bacteriologist for the City of Salford—The Medical Officer of Health, 143 Regent Road, Salford (October 11). An assistant lecturer in the principles of teaching (logic, psychology and ethics) at the Glasgow Training Centre of the National Committee for the Training of Teachers—Director of Studies, Training Centre, Jordanhill, Glasgow (October 16). An assistant pathologist at the Royal Free Hospital and London School of Medicine for Women—The Secretary, R.F.H., Gray's Inn Road, W.C.1, or The Warden and Secretary, London School of Medicine for Women, Hunter Street, W.C.1 (October 18). A professor of mathematics, a reader in physics and a reader in chemistry at Raffles College, Singapore—The Board of Education or the Scottish Education Dept., Whitehall, S.W.1 (October 22). A lecturer and demonstrator in chemistry and a lecturer in pharmacy in the University of Sydney, New South Wales—The Agent-General for New South Wales, Australia House, Strand, W.C.2 (October 30). An Editor for "Science Abstracts" having a knowledge of physics, electrical engineering and foreign languages—The Secretary, Institution of Electrical Engineers, Savoy Place, Victoria Embankment, W.C.2 (November 8). An assistant curator in zoology in the Bristol Museum and Art Gallery—The Director (November 15). A State mining engineer to the Western Australian Government—The Agent-General for Western Australia, 115 Strand, W.C.2 (November 30). The "J. C. White" lectureship in bacteriology in the Queen's University, Belfast—The Secretary (December 1). A teacher of biology at Gordon College, Khartoum—The Sudan Government Offices, Wellington House, Buckingham Gate, S.W.1 (marked "Teacher of Biology"). A warden of the Ellis Llwyd Jones Hall of Residence for Women Students, Victoria University of Manchester—The Registrar of the University. A lecturer in mathematics at the Chelsea Polytechnic—The Secretary, Chelsea Polytechnic, Manresa Road, S.W 3.

Our Astronomical Column.

THE METEORIC PHENOMENA OF SEPTEMBER 6.—Mr. W. F. Denning writes that, with reference to the meteoric phenomena observed on Monday, Sept. 6, though there were probably two different meteors seen at about $20^{h}\ 45^{m}$ G.M.T., the various observations are not sufficiently definite to determine the real paths with certainty except in one case. This refers to the great fireball which was directed from the north-east and passed over Yorkshire from the North Sea to disappear finally over Matlock, Derbyshire. Its height was from 60 to 28 miles, path about 133 miles, and velocity 15 miles per second. The radiant point was near ϵ Persei over the north-east horizon at the time of the fireball's appearance.

Statements have appeared in the newspapers that a London photographer released a number of gas balloons earlier in the same evening. Those were so arranged as to acquire altitudes of about 5000 feet and to explode finally with great noise and light. The originator of the scheme alleges that he sent the balloons up as an 'amusement' and 'experiment,' and claims that the supposed meteors and curious flashes observed on the same evening were the products of his experiment. This claim cannot apply to the Yorkshire fireball at least, which gave a dazzling illumination, occasioned loud detonations, and caused buildings to vibrate as during an earthquake. A small gas bag could scarcely induce results of this character.

DESIGN OF A 25-FOOT REFLECTOR.—There is no finality in telescope design, and Mr. F. G. Pease, of Mt. Wilson Observatory, pronounces that the making of a 25-foot mirror is quite within the bounds of possibility, and gives a design for such an instrument and its dome in *Publ. Astr. Soc. Pacific* for August. He makes the focal length only 3·3 times the aperture, so that the dome has only twice the span of that of the Hooker telescope. The estimated cost is 12 million dollars. Various materials are suggested for the mirror: glass, pyrex, obsidian, stainless steel, Mr. Pease is not without hope that an alloy may be found with a low coefficient of expansion like invar, but superior in reflective power.

The proposed instrument would carry a 70-foot interferometer. Mr. Pease considers that the climate of Mt. Wilson would permit of the effective use of such an instrument on nearly as many nights as the 100-inch Hooker telescope

CATANIA OBSERVATORY.—This observatory undertook the photography of the zone $+46°$ to $55°$ of the Astrographic Catalogue The printing of its results is much in arrears, owing to shortage of funds since the War and frequent changes of directors (A. Ricco died in 1919 and B. Viaro in 1922), but the appearance of Vol. 2, Part 2 will be welcomed. This extends from declination to $-49°$, and from R.A. 3^{h} to 6^{h}. There are 48 pages of catalogue, with an average of about 120 stars on each, going down to mag 12·2 (photographic). The information given is fuller than in most astrographic catalogues, R.A. and decl being given for all stars (to $0{\cdot}01^{sec}$ and $0{\cdot}1''$), also meridian positions and spectral types for all stars for which they are available. There is difference of opinion as to the advisability of thus increasing the size and cost of the work, but there can be no question that it makes the catalogue much more convenient for reference.

The *Annuario* of the Observatory for 1926 contains drawings of sunspots and prominences by G. Favaro, and of Mars (opposition of 1924) by M. Maggini. The latter show an unusual number of small round markings, both bright and dark; some of the former may be clouds. A bright bridge crosses Syrtis Major, a feature that others have noticed at times.

Research Items.

ANALYSIS OF PREHISTORIC BRONZE.—Mr. A. Leslie Armstrong publishes, in *Man* for September, a number of analyses of bronze implements and founder's metal made by Prof. Desch in connexion with the work of the Bronze Age Implements Committee of the British Association. A palstave found at Windsor in 1864, formerly in the Hull Museum and now in the Ashmoleum Museum, Oxford, was one of the most interesting of the objects examined. Its metal had an abnormal appearance, and on analysis it proved to contain so much oxygen and sulphur that the metal was "hopelessly brittle" and could only be regarded as a founder's failure. The figures were copper 78·79, tin 16·49, nickel 0·49, lead 0·09, sulphur 0·68, total 96·54. Three implements from a hoard found at Westcroft, Shelf, near Halifax, were also brittle owing to excess of sulphur, the analysis of one revealing 1·50 of sulphur, copper 86·32, tin 12·14. The Everthorpe Hoard of thirteen socketed celts, a gouge, and three lumps of metal, now in the Hull Museum, was also examined, and revealed the surprising fact that the metal was practically pure copper, a condition unusual in English objects. The celts are unfinished foundry specimens and the analyses of three samples were practically identical, showing 98 to 99 per cent. of copper. A socketed celt, however, from the same hoard showed the remarkable result of copper 66·88, tin 10·54, and lead 22·36. Such an amount of lead is probably unique.

THE 'A' CEMETERY AT KISH, MESOPOTAMIA.—The Field Museum, Chicago, has undertaken the publication of the technical description of the pottery, metal, and stone implements, and other details of the more material side of the archæological discoveries of the Field Museum-Oxford University Expedition to Kish The first part, Vol. 1, now issued is by Mr. E. Mackay, the excavator, and deals with the finds in the 'A' cemetery, close to, and south of, the Ingharra series of mounds. This site was partially excavated between January and March 1924, when thirty-eight graves were opened. The finds presented many points of particular interest. On the site, which awaits further excavation, was a large building of plano-convex bricks, which had afterwards been enlarged, and after a considerable lapse of time the addition was repaired. The burials are dated at about 3000 B.C., when the buildings had fallen into a state of decay. The skeletal remains show that though the legs were bent, the bodies were not interred in the 'crouched' position and there is no indication of a rule of orientation. The pottery includes new and important types, the most striking being the handled form which is unique in Mesopotamia or elsewhere found in nearly every grave. It is made in three pieces skilfully joined, the chief peculiarity being the handle, which is hollow, and has the face and breasts of a female in clay applied to it. It is clearly in origin a spout, as in some cases the cavity of the handle communicates with the interior of the jar, and in no case is the handle actually secured to the rim. Nearly every grave was supplied with a pottery brazier made in two pieces. Nothing quite like them has been found excepting the Hittite 'champagne cups' of Bronze Age date, and a vessel from the prehistoric burials of southern India conjecturally dated 2500 B.C. Copper implements were numerous, especially knives and daggers. They were beaten out of thin sheet metal and as they seem too light in weight for actual use, were probably made for funerary purposes. Curious implements of sickle shape of which the use is difficult to determine may, it is suggested, have been used as strigils. The designs on the seals, as usual, throw light on the general culture of the period. The fauna represented suggests a semi-arid climate such as that of South Africa, and it is interesting to note that an antelope apparently was domesticable.

FOREST ECOLOGY IN SWEDEN.—The Swedish Institute of Experimental Forestry in 1923 acquired two forest areas in Västerbotten, northern Sweden, for scientific studies. Kulbäcksliden is about four square miles in area, and Svartberget is slightly smaller. In "Excursion Handbook" No. 11 of the Institute, the geology and vegetation of these forest areas are described by Messrs. O. Tamm and C. Malmström, with maps of the soil and vegetation formations. Over the greater part of the areas the plant communities have suffered no interference by human agency. The predominant tree is the Scots pine, but there is a considerable proportion of spruce. From an investigation of fossil pollen in peat bogs M. Malmström believes that pine and birch used to prevail, while spruce was absent or rare, and did not become an important forest tree until perhaps four thousand years ago. Spruce pollen increases rapidly in amount in later peat deposits, suggesting a rapid invasion of this tree. At the same time elm and lime disappeared. Spruce seedlings have an advantage over pine and birch in needing very little light. Thus as competition and crowding increases, the spruce is best able to hold its own. On the other hand, spruce has less resisting power than pine against forest fires, so that after a fire the pine again has a chance until eventually crowded out once more by spruce.

KAPOK.—The *Bulletin of the Imperial Institute*, vol. 24, No. 1, 1926, has an article, with bibliography, upon the prospects of the production of this fibre within the British Empire. The tree producing kapok, *Eriodendron anfractuosum*, belongs to the natural family Bombacaceæ and occurs in many tropical parts of the British Empire, but practically the entire commercial supply of the fibre is obtained from Java. On a relatively small scale it has been cultivated with success in Ceylon The hairs in kapok are attached to the inner wall of the capsule and not to the seed itself, so that the separation from the seed is much more easy than in the case of cotton. The hair cells are full of air and very light, and as they are unpermeable to moisture they are used throughout the world for the manufacture of life belts and similar appliances, but the chief use of kapok at present is for stuffing cushions, mattresses, etc. Hitherto great difficulty has been experienced in spinning kapok, owing to the smooth, slippery surface of the fibre, when this difficulty is overcome the yarn may not be strong enough for some purposes, but in the production of good non-conducting fabrics and in other directions kapok may find an extensive field of employment. The seed is rich in oil, and in the Dutch East Indies forms an important source of revenue. Cultivation of the kapok tree seems to offer few difficulties in a suitable climate, and propagation, either from seed or cuttings, is a simple matter.

FUNGI.—The Ministry of Agriculture and Fisheries has published 25 coloured plates, of a few (sixteen) of the edible British fungi and also of nine of the more dangerous poisonous species (London: H.M.S.O.). This handbook replaces a former edition, now out of

print; names and description have been brought up-to-date, and seven new plates inserted, four of more common species in place of rare species now omitted, three as more representative illustrations of the same species than the figures in the former handbook. The illustrations are clear and the description as non-technical as possible, but it is doubtful whether it is advisable for any but the competent mycologist to range so widely in his diet of fungi. The handbook is very cheap at 3*s.* in S/Cloth Boards or 2*s.* 6*d.* Quarter Boards. In the *Annals of the Royal Botanic Gardens, Peradeniya*, vol. 10, part 1, T. Petch continues his "Additions to the Ceylon Fungi," whilst the *Kew Bulletin*, No. 7, 1926, contains an account of the Fusaria of Jamaica, by C. G. Hansford. Dr. Paul A. Murphy and Robert M'Kay have a paper upon the downy mildew of onions (*Peronospora Schleideni*, Unger) in the *Scientific Proceedings of the Royal Dublin Society*, vol. 18 (N.S.) No. 22, 1926. Perennating mycelium in the bulbs seems to be the main method by which this disease hibernates in Ireland. In the *Transactions of the Royal Scottish Arboricultural Society* Dr. Malcolm Wilson, with collaborators, publishes brief notes upon *Rhizosphæra Kalkhoffii* Bubák, as a cause of defoliation in conifers, and upon *Rhabdocline Pseudotsugæ* Syd., a new disease of the Douglas fir in Scotland.

BLOCK LAVA AND ROPY LAVA.—It is well known that there are two contrasted types of lava flows known as *aa* or block lava and *pahoehoe* or ropy lava. The rough surfaces of the former are moderately crystalline, whereas the latter is covered with a smoother layer of glass which varies in vesicularity from a continuous solid to a froth. A flow frequently starts as *pahoehoe*, especially where the rate of flow is not too high to permit skins of chilled glass to form over the surface, while further on *aa* is formed. This may occur where there is an increase of slope giving turbulent conditions, or when the underlying lava stream has begun to crystallise so that it can no longer advance in a completely liquid state. At Mauna Loa most of the *pahoehoe* is formed during the declining phases of activity; crusts then form over the lava, which flows slowly in tunnels and advances by pushing out bright toes along the front of the stream. These in turn rapidly crust over, and the conditions are very different from the raging torrents with which the flank eruptions often begin. Experiments carried out by O. H. Emerson, and recorded in the *Am. Journ. Sci* for August, together with many pertinent field observations, converge in showing that *aa* lava is essentially due to crystallisation of the mass while it is flowing. It is concluded that the controlling factors in determining the final appearance of a lava flow are mainly mechanical, such as the thickness and viscosity of the flow, its degree of crystallisation at any given time, and its velocity. It has been thought that *aa* is formed by containing and releasing more gas than *pahoehoe*, for the bursting of vesicles often contributes to the roughness of a lava surface. Dr. Jaggar, however, is quoted to prove that there is no evidence as to which of the two forms, if either, gives off the greater quantity of gases.

ARCHÆAN ROCKS OF SOUTHERN INDIA.—In his presidential address to the Geological Section of the Indian Science Congress of 1924, now published in the *Records of the Mysore Geol. Dept*, 23, 37, 1926, Dr. W. F. Smeeth discusses the sequence and origin of the gneisses and associated rocks of Mysore. He adheres to his view that the chloritic and hornblendic rocks of the Dharwar group are the oldest of the complex, and that the gneisses, charnockites and granites are successive intrusions of later dates. Nevertheless, no sign has been detected of any old land surface or basement rock on which the oldest Dharwars could have been laid down or erupted. This failure has led to the hypotheses that the original underlying floor, together with the base of the Dharwars themselves, have been re-fused, or that they have foundered into the depths after having been stoped away by a magma rising from deeper sources. The upper or chloritic division of the Dharwars shows as a whole more folding and shearing than the lower or hornblendic division, and the contact relations indicate that the latter are, for the most part, intrusive towards the former. Confirmatory evidence is found in the structural relations of the banded quartz-ironstones that are developed among the chloritic schists. Acid intrusions which have been thought to be offshoots from the later Champion Gneiss are stated to be more abundant in the upper division than in the lower, and this discrepancy is met by the suggestion that some of them are associated with a period of granite intrusion still earlier than that of the Champion Gneiss, and also earlier than the intrusion of the hornblendic series.

BRAZILIAN METEOROLOGY.—The observations taken at the Central Observatory at Rio de Janeiro in 1921 are tabulated in full in the *Boletin Meteorologico* published by the Ministry of Agriculture. They are followed by a summary of the observations taken at some 80 other stations, and rainfall data at 25 other stations. In an appendix there are added the data obtained from various private observatories, owned mainly by railway and mining companies. The volume contains detailed rainfall maps, so far as statistics permit, for every month in the year. The lack of data in the far interior is noticeable in these maps, which show only five stations in the basin of the Amazon and its main tributaries. On the coast, however, the stations are numerous.

RECURRING MAGNETIC DISTURBANCES.—Largely through the work of Maunder and Chree, the '27-day recurrence tendency' is one of the most firmly established facts of terrestrial magnetism: the phrase denotes the tendency for a day following or preceding, at an interval which is an integral multiple of 27 days, a day of marked magnetic disturbance or calm, to share the same characteristic in diminished measure. The tendency is attributed to the association of magnetic disturbance with corpuscular emissions from particular disturbed regions of the solar surface: if on a given day such a region is suitably disposed towards the earth, so that its emissions impinge on the earth, then 27 days later, in consequence of the solar rotation, it will recur to approximately the same aspect relative to the earth, and if still active there will be recurrence of terrestrial magnetic activity at this interval; it is known that particular solar regions often remain disturbed for the duration of more than one solar rotation-period. The same hypothesis applies, *mutatis mutandis*, to days of magnetic calm, which are naturally associated with notably calm regions on the sun's surface. In *Terrestrial Magnetism*, June 1926, W. J. Peters and C. C. Ennis use the Ebro observations of 1910–1924 to prove that earth currents exhibit the same recurrence-tendency. This was to be anticipated, since it is almost certain that these currents are induced in the earth by the variations in the earth's magnetic field (themselves originating in electric currents

situated in the atmosphere); it is satisfactory, however, to have this anticipation confirmed.

THE ACOUSTICS OF BUILDINGS.—As the result of experiments which have been carried out at the National Physical Laboratory, Teddington, during the last two or three years, architects can now be told what will be the acoustical properties of any hall designed by them, before it is erected. The apparatus used in the predetermination of these properties is described by Dr. A. H. Davis and Mr. N. Fleming in the September issue of the *Journal of Scientific Instruments*. For the effects of floor, ceiling, side walls, and galleries, a small model in hard wood is made, the end walls being omitted. A spark from an electric machine is made to pass between two electrodes placed in the model at the point at which in the hall the sounds are produced, and, after a short interval, a second spark is made at a point in the model which corresponds to a point behind the source of sound in the hall. The position of the sound wave due to the first spark is shown by the shadow it casts on a photographic plate placed in the model at a point corresponding to one behind the back wall of the hall. By changing the interval between the two sparks, the sound waves before and after reflection are followed.

THE CATALYTIC DISSOCIATION OF CARBON MONOXIDE.—The reversibility of the reaction $CO_2 + C = 2CO$ was demonstrated by Deville in 1863, and although numerous experiments on the thermal decomposition of carbon monoxide, alone or in the presence of catalysts, have been carried out since that time, the existence of this equilibrium at comparatively low temperatures has but recently been observed. The minimum temperatures at which various catalysts cause the decomposition of pure carbon monoxide were determined by J. Cleminson and H. V. A. Briscoe in a series of experiments described in the August issue of the *Journal of the Chemical Society*. The pure gas was heated in a durosil vessel, connected with a mercury manometer, in the presence of the catalysts, the diminution in volume serving to measure the extent of decomposition. The temperatures at which the decomposition began were 300°, 290°, and 250° for carbon, magnesia, and alumina respectively.

FUMIGATION WITH HYDROCYANIC ACID.—Fumigation with hydrocyanic acid gas is the subject of *Science Bulletin*, No. 46, published by the Department of Agriculture of the Union of South Africa, which details the work of B. J. Smit and T. J. Naude on the distribution of the gas in a tented enclosure. In order to find the conditions for the most efficient fumigation, samples of the gas from different parts of a treated brick-chamber were drawn through potash solution and the hydrocyanic acid concentrations estimated. When the pot method is used, it is found that, under the influence of the heat of reaction between the hot sulphuric acid and the sodium cyanide, the gas rises to the top of the chamber and descends along the walls to the floor, the dose being in excess of the theoretical for the first few minutes. In fumigations with liquid hydrocyanic acid, the distribution of the gas depends on the nature and area of the surface on which the liquid is poured, but when the evaporation is aided by heat the results resemble those obtained by the pot method.

EKA-CÆSIUM.—Various attempts have recently been made to isolate eka-cæsium, the hitherto missing element 87. Assuming that $MsTh_2$, an actinium isotope, might undergo dual disintegration, and emit a small number of α-particles in addition to its normal β-ray disintegration, O. Hahn recently attempted to detect the missing element. He concluded that eka-cæsium, provided it has a half-value period of not less than a few hours, does not result from the disintegration of $MsTh_2$. Using the scintillation method, G. Hevesy has also investigated the problem of the missing element by counting the α-particles emitted by RdTh during its growth from $MsTh_2$. His results indicate that the fraction of $MsTh_2$ atoms which disintegrate under emission of α-particles is certainly less than 1/200,000. In a recent paper (*Phys. Zeit.* 27, p. 531, August 15, 1926), O. Hahn and O. Erbacher have carried the investigation a stage further. They used strong $MsTh_2$ preparations, of strength equivalent to 24-32 mgm. radium, which they freed completely from isotopes of radium, lead, and bismuth in the presence of iron, after which cæsium nitrate was added, and the $MsTh_2$ quantitatively separated from it. The cæsium was then precipitated, carefully washed and dried, and transferred to an electroscope. The measurement of its activity was commenced about thirty minutes after separation of the $MsTh_2$. The residual activities were probably due to traces of $MsTh_2$, and were so small that the authors conclude that if eka-cæsium is produced from $MsTh_2$ and has a half-period within the limits of a few minutes and ten years, the branching ratio is not greater than one in ten millions. By the observations of the β- and γ-activities of their purified $MsTh_2$ preparations during a period of 50 hours, four accurate decay curves of $MsTh_2$ were obtained, and these yield a mean value of 6·13 hours for the half-period of $MsTh_2$ ($\lambda = 0{\cdot}113$ hour^{-1}). This result agrees fairly well with the earlier determinations, but indicates that the value $T = 5{\cdot}95$ hours obtained by W. P. Widdowson and A. S. Russell is distinctly low.

AN ARABIC TREATISE ON ALCHEMY.—Additional information on the "somewhat shadowy figure" of Abu 'l- Qāsim al- 'Irāqī, an Arabic alchemist of the 13th century, whose work "Al- Muktasab" (Arabic text and English translation, Paris 1923) was published by Mr E. J. Holmyard, and was reviewed in NATURE (Aug 30, 1924, p 307), is now available in the July number of *Isis*. Mr Holmyard here gives translations of parts of other works of Abu 'l- Qāsim, in which (as in the first treatise) the influence of Alexandrian writers is very clear. In a list of secret names ("Decknamen") of materials, many are those "used by the Greeks". Among the names of mercury is "liquid gold" (which Mr. Holmyard does not comment upon). The Greek name is "liquid silver" (χυτὸς ἄργυρος in Aristotle, the earliest mention), but Ktesias mentions an Indian "liquid gold" (ὑγρὸς χρυσός). The elixir is called *al-tiryāq* (θηριακή, a nostrum invented by Andromachus of Crete, physician to Nero, which Sprengel says "was later applied without distinction to all the kinds of diseases"). Supposedly Greek names, which are obviously greatly disfigured, are left by Mr. Holmyard without comment. Among these are *halimus* for hæmatite (? *al īmus*, αἱματίτης); *isqūnās*, purified sulphur (? from φεῦγον, the sulphur being sublimed); *mughlīs*, salt of urine (probably made up from ὄμιχμα and ἅλς); *faluzabalis*, white lead (perhaps containing λιθάργυρος; the name 'Αφροσέληνον suggested by Mr. Holmyard seems improbable); *harfatis*, copper scales (Ruhland, *Lex.* 29, says *alfatida* is "cuprum ustum"); *badis*, trona (Ruhland, 100, *barach panis* is "nitrum salis"), *raus*, sulphur, etc.

Jubilee of the Mineralogical Society.

The opening of the Jubilee Celebration of the Mineralogical Society on Tuesday, September 21, was preceded by a very successful week's excursion to Cornwall under the leadership of Mr. Arthur Russell, which was attended by about eighteen members and guests.

On Tuesday, September 21, an informal gathering in the Mineral Gallery of the British Museum (Natural History), South Kensington, was followed by a visit to the Imperial College of Science, where was shown a series of exhibits in the Geological Department, and Prof. H. C. H. Carpenter exhibited and gave an account of the large crystals of aluminium and other metals that he has succeeded in making.

The afternoon began with a most interesting visit to the Royal Institution, where Sir William Bragg and his assistants showed models of crystals and the results obtained by the X-ray analysis of minerals. Sir William Bragg also took his guests over the Institution and showed the historic laboratories of Faraday, and the apparatus employed by him and by other famous investigators. Later in the afternoon, at the Jermyn Street Museum, Sir John Flett and the Museum curators exhibited the mineral and other collections, the library, and map-room, and entertained the visitors at tea.

The formal reception took place in the evening of Tuesday at a conversazione held by kind permission in the rooms of the Geological Society at Burlington House. Here Mr. Campbell Smith had arranged an interesting collection of apparatus and specimens. The latter included a beautiful set of gold nuggets, got together by one of the oldest members of the Mineralogical Society, Prof. Liversidge. The apparatus, consisting of goniometers, refractometers, etc., all of British workmanship, was mostly of recent design, but part was old and of historic interest from its association with earlier workers. After the formal reception the President delivered a short address dealing with the history of the Society, its relations with other kindred societies, and the main lines of work which it has accomplished and published.

The exhibits at the Geological Society's rooms were on view during the following day, September 22, and were visited and examined by many who had had too little opportunity on the previous evening. By kind permission of the Provost of University College, parties were also able to visit at 134 Gower Street the beautiful collection of Vesuvian rocks and minerals formed by the late Dr. H. J. Johnston-Lavis, and bequeathed by him to the University of London. In the afternoon the party was received at the Imperial Institute by Sir William Furse and Sir Richard Redmayne, who gave an account of the collections, and the intention of those in charge to make the Institute a new educational instrument with the definite aim of illustrating the products and characteristics of the various parts of the British Empire. The party then proceeded to the British Museum (Natural History), where they were received by the Trustees, the Assistant Secretary, and the Keepers of Mineralogy and Geology, and were shown some of the chief features of the Mineralogical Collections. Afterwards the party were photographed and entertained at tea provided by the Government.

The London part of the celebration closed with a dinner at the Connaught Rooms, at which about seventy were present, the chief speakers being Dr. Harry von Eckermann (Sweden), Prof. Paul Niggli (Switzerland), Prof. F. Wigglesworth Clarke (U.S.A.), Prof. J. L. H. Borgström (Finland), Prof. F. Rinne (Germany), and Dr. H. Ungemach (France), for the foreigners, and Sir Henry Miers, Sir Thomas Holland, Sir John Flett, and the President of the Mineralogical Society, for the hosts.

Letters were communicated, bearing messages of congratulation from many foreign societies which had been unable to send representatives to the gathering, among the most interesting being those from Prof. Victor Goldschmidt of Heidelberg, from Prof. Paul Groth, Prof. A. Lacroix, Prof. E. S. Dana, the veteran Gustav Tschermak, Dr. H. Michel, Prof. J. Morozewicz, Prof. F. J. Becke, Prof. F. Zambonini, and the Mineralogical Societies of Vienna, Russia, Hungary and America. Addresses were read and presented from the Geological Societies of Poland and Cornwall, and it was resolved to send telegrams of greeting to Prof. Tschermak, Prof. Dana, Prof. Goldschmidt, and Prof. Groth representing the oldest of the honorary members of the Society, and to Mr. B. Kitto, Prof. A. Liversidge, Dr. R. Pearce, and Mr. C. J. Woodward, veteran ordinary members of the Society, the last being one of the two survivors of the Crystallological Society.

On the following morning about a dozen left Euston for the north of England with Prof. A. Hutchinson of Cambridge, to study the Shap and Carrock Fell areas, the Alston district, and other famous mineral localities. The excursion closed at Cambridge on Friday, October 1, with visits to the Mineral Laboratories of the University and of Dr. A. E. H. Tutton.

The President of the Mineralogical Society, Prof. W. W. Watts, in his presidential address, extended a very warm welcome on behalf of the council and members of the Society to those who had come from far-distant parts of Europe and America to join in the celebration. He pointed out that the Society was not the first of its kind in Great Britain, but had been preceded in 1799 by a body who formed "The British Mineralogical Society," and continued active for seven years when they rejoined the Askesian Society, a selected number of which formed the nucleus from which the Geological Society grew. The minute book of that old Mineralogical Society is still preserved in the Science Library, and by the kind permission of Sir Henry Lyons was exhibited at the conversazione.

In the same year as the Mineralogical Society was founded, a more academic body, at first called the Crystallometric Association and afterwards the Crystallological Society, was formed, but it amalgamated with the Mineralogical Society in 1883, bringing with it such men as Maskelyne and Lewis, Fletcher and Miers, who afterwards served as presidents. As a result of this happy combination, the Mineralogical Society was free to publish crystallographic as well as its other purely mineralogical work.

The Society was fortunate in securing Henry Clifton Sorby as its first president and keeping the "Father of Petrology" in the chair for three years. His influence on the Society was very great, both in the optical and microscopic work which he founded, and in adding the advancement of the knowledge of petrology as one of the objects of the Society.

Sorby was followed by a line of presidents each of whom rendered conspicuous service to the science and to its Society; Heddle, with his long list of works on Scottish mineralogy; Bonney, with his series of papers on rocks and rock-forming minerals; Hudleston, of wide travel and critical instinct; Scott, with his broad chemical knowledge and his service to the finances of the Society; Fletcher, who not only wrote a series of masterly papers on meteorites but also revolutionised

crystal-optics by his conception of the optical indicatrix; Maskelyne and Lewis, professors of mineralogy at Oxford and Cambridge respectively, famous for their crystallographic work,—to mention only some of those who are no longer with us.

The work of these men reflects that of the Society. Always there have been pure mineralogical papers dealing with mineral types or mineral groups, topographic papers concerning areas at home and abroad famous for their unique or abundant minerals, and petrographic papers dealing with the naturally occurring associations of minerals. These have depended upon chemical analysis, measurement of crystals, and determinations of optical characters as revealed by the microscope and other optical instruments.

In addition to this there have been a number of papers devoted to the mathematical aspects of crystallography, to the expression of internal structure by outward form, to the physiology of mineral growth, repair, and destruction, to the minerals used as gems or for other economic purposes, their associations and genesis, and of later years to the atomic and molecular structure of crystals as revealed by X-ray analysis.

The organ of the Society, the *Mineralogical Magazine*, has appeared regularly throughout the life of the Society and, in addition to original communications read at the meetings, has contained abstracts and reviews, and lists of new mineral names. During the last few years (since 1920) the Society has published sections of mineralogical abstracts. These give concise accounts of mineralogical papers and works published elsewhere, and have been of the greatest service to all workers in mineralogy, crystallography, and petrology. Indeed, the Society has never been more active than at present, and there is every promise of a brilliant and useful future.

Classification of Amœbæ.[1]

THE purpose of the memoir before us is to set forth a description of 39 new species and 11 new genera of Amœbæ and to propose a classification of Amœbæ. That a revision of the systematics of Amœbæ is desirable is unquestioned. The author has endeavoured to obtain a secure basis for his revision by prolonged observation of the various species, several of which have been raised in cultures from a single example. Variations within the species such as have been frequently assumed and even asserted to occur by some writers were not found, and the author states that most free-living amœbæ can be recognised specifically at least as readily as ciliates or beetles. No special difficulty is met with in classifying about three-fourths of all the known species of Amœbæ, but the remainder are small species the morphology of which has not been studied with sufficient care for the purpose. The supposed shapelessness of Amœbæ has led to previous attempts to classify species wholly with respect to nuclear characters, but the author states that such a systematic basis is no more defensible here than it would be in other protozoa. The genus Protamœba has been defined as lacking nucleus and vacuoles; the author suggests that the enucleate daughters which occasionally arise during fission of an amœba have provided the basis for this genus, the validity of which he therefore doubts, and Gloidium has scarcely a better standing.

Prof. Schaeffer differentiates pseudopodia into determinate and indeterminate. The former grow to a more or less definitely limited size and are then withdrawn; they are generally conical and composed of clear protoplasm only, and they are usually extended only on an advancing part of an amœba. Indeterminate pseudopodia are not restricted as to size; they direct locomotion and may grow large enough to form the entire amœba. They are more or less cylindrical and filled with granular protoplasm.

In putting the question "How many good species of Amœbæ are now known?" the author states that it is not yet possible to give a definite answer. The large, free-living species hitherto described amount to about 85; the parasitic and culturable species are about 70, and with the new species described in the present paper the total number approaches 200. A natural system of classification of the amœbæ must be based on the larger species, and it is with these the author chiefly deals. The changes of form exhibited by an amœba are characteristic and provide the basis for a natural classification. He regards Trimastigamœba, a minute amœba which can take on a flagellate condition, as the most primitive genus.

Prof. Schaeffer describes the different conditions—natural and cultural—under which he has observed his material. He states that no species has yet been found to live and reproduce in both fresh and salt water, though one species can be transferred from sea water to fresh water without apparent injury, and will live about ten days, but reproduction was not observed. More species of amœbæ and more individuals are to be found in tidal pools rich in diatoms than under any other conditions.

The author discusses problems of nomenclature and considers that 'Amœba' must go and be replaced by 'Chaos,' and that the Amœba first called 'der kleine Proteus' (Roesel, 1755) is the same as *Proteus diffluens* Muller and the correct name is *Chaos diffluens*. On submitting this conclusion to about a score of representative American zoologists, the majority expressed their general agreement, but the author wisely remarks that it might be desirable to bring the case before the International Commission for consideration and decision.

The main part of the volume is devoted to careful descriptions of the species, and these are supported by excellent lithographed figures. The memoir forms a most important contribution to the systematic study of Amœbæ.

[1] "Taxonomy of the Amebas, with Descriptions of Thirty-nine new Marine and Freshwater Species." By Asa Arthur Schaeffer. Papers from the Department of Marine Biology of the Carnegie Institution of Washington. 115 pp. 12 plates. Washington, 1926.

Ventilation in Factories.

THE importance of a proper system of heating and ventilation in factories for the comfort and health of the workers need not be emphasised. Considerable difference of opinion as to the correct system probably exists amongst engineers, so that a scientific examination of various common methods should prove of value in selecting that one which the workers find most satisfactory. Dr. H. M. Vernon and T. Bedford[1] have recently made a physiological study of the ventilation and heating in certain factories.

[1] Medical Research Council: Industrial Fatigue Research Board. Report No. 35: A Physiological Study of the Ventilation and Heating in certain Factories. By H. M. Vernon and T. Bedford, assisted by C. G. Warner. Pp. iv+82. (London: H.M. Stationery Office, 1926.) 3s. net.

Continuous records of air velocity and air temperature were taken by means of the hot-wire anemometer and the thermopile respectively. Vane anemometers to determine the directions of the air currents were also used, as well as the katathermometer for direct estimations of the cooling power of the air. The following may be considered the criteria by which a heating and ventilating system should be judged. The room should feel comfortably warm and fresh, yet be without draughts, the temperature at head level should be cooler than that at the level of the feet, and the incidence of sickness and ill-health should be a minimum.

The ideal temperature appears to be about 60° F.-63° F. The cooling power should be 7·0 in winter and about 6·0 in the hot weather, the difference being due to the acclimatisation of the body to the different seasons. These cooling powers can be attained with air velocities of 30 ft. per min. in winter and 50 ft.-100 ft. per min. in summer. The room feels 'too warm' when the temperature rises 4° F. and the cooling power falls one unit, and 'too cold' under the reverse conditions.

An important index of the actual temperature conditions is the temperature gradient from the floor level to the region of the head or higher. It is greatest when the heating system is placed above the heads of the workers: in fact, such a system is roundly condemned as leading to cold feet and hot heads and their accompanying discomforts, and should only be used in conjunction with a heating system at a lower level, when it is desired to avoid down draughts from skylights. The lowest gradient was found when the heating system was placed *under* the floor, and when at floor level it was nearly as satisfactory. The temperature used should not be too high, else the air currents induced become too rapid. It is important that these should be directed upwards, since expired air travels upwards, being lighter than room air, and hence with a down draught there is danger of the workers having to breathe each other's expired air, with the attendant risks of possible infection.

The system of ventilation which gave least draughts and yet most freshness to the air was one of natural ventilation by means of windows, with fan exhaustion in addition if necessary; the outlets for the latter should be situated 7 ft.-8 ft. above the floor. If a plenum system is installed, it should deliver the warm air near the floor from small inlets, and not from inlets situated above the heads of the workers; the latter leads to discomfort and is wasteful of energy. A plenum system delivering *cool* air above head level in conjunction with floor warming gives the most satisfactory type of heating when natural ventilation cannot be utilised.

The efficiency of any given system can be determined from the cooling power and its velocity and temperature components, together with a knowledge of the available window area and the extent to which it is utilised. The latter should be considered relative to the floor area and not to the cubic capacity of the room, since the ventilation is slightly better in a higher room than in a lower one with the same window and floor area.

Evidence is adduced in the report to show that the incidence of sickness is less in workrooms with a good ventilation and a satisfactory mean temperature. The report should, indeed, be studied by all who take part in the designing of modern factories.

International Agreements affecting Port Sanitary Work.

SIR GEORGE BUCHANAN gave a valuable address upon the above subject at the conference of Port Sanitary Authorities during the recent London congress of the Royal Sanitary Institute. He had recently attended on behalf of the British Government the fourth International Sanitary Conference at Paris, at which seventy nations were represented; and he considered that some good results had been achieved. The conference was held with the object of revising and bringing up-to-date the International Sanitary Convention, 1912, under which the various signatory governments agreed upon mutual action and common standards for dealing with the diseases liable to be carried on ships, including cholera, plague, typhus, smallpox, and yellow fever. The conference laid down some new lines of international action which are of great importance to British port sanitary authorities, on whom rests the daily burden of protecting their ports, as well as the rest of the country, from the risks from the importation of these diseases.

The deficiencies of the 1912 International Sanitary Conference have been obvious for many years. To take one example: a ship was only held to be 'infected' with plague when human cases of the disease had occurred during the voyage; but the most dangerous ship of all, with swarms of rats among which plague is prevalent, was not so classified and therefore came under no regulations.

In the new Convention an effort is made to increase the measures whereby countries may obtain all possible intelligence regarding the prevalence of certain infectious diseases. It gives further encouragement to the existing system of interchange of information regarding the incidence of infectious diseases by requiring the signatory governments to reply to any inquiries addressed to them, from the Office Internationale d'Hygiene Publique, for information on any subject affecting the risks of transmission of infectious disease from one country to another. Thus the Office Internationale will discharge the duty of acting as a kind of clearing house for information; and it is authorised to make agreements which will avoid duplication of effort.

In reference to plague, the establishment of new definitions by which a ship with plague-infected rats becomes an 'infected' ship, and a ship with an unusual mortality among rats, a 'suspected' ship, was readily agreed to, as was also the authorisation of measures to prevent rats reaching the shore directly or through merchandise. In ports designated as sufficiently equipped to undertake effective rat destruction, systematic measures will be required to be undertaken once in six months, and a certificate that this has been done, specifying methods and results, will carry the ship on to the next half-yearly period. The inspection officer is authorised to exempt from systematic measures when circumstances permit, and to issue an exemption certificate, which is also valid for six months.

In case of other diseases the measures required by the new Convention have been made to conform to our latest knowledge and experience; and all those applicable to the ship, passengers, and crew have been made strictly reasonable, the aim being to make them more efficacious and, where possible, less burdensome. Seeing how much of the world's immunity from pestilence is due to the measures outlined above, and to the spade work of the port sanitary authorities and their officials, the public has reason to be grateful to the representatives of the seventy nations for the valuable work they have accomplished.

The Measurement of Ocean Currents.[1]

THE application of Bjerknes' circulation theory to the movement of water masses in the oceans has provided a method of increasing utility for the study of ocean currents. If the temperature and salinity of the ocean are given for several known depths at several positions, the difference in velocity of the current at the surface and the various depths can be computed and mapped. It is frequently possible to make observations down to a depth where it may be assumed that no appreciable current exists.

In 1914 a survey in the neighbourhood of the River St. Lawrence was carried out for the Canadian Government by Dr. Johann Hjort and the data obtained were worked up by Prof. Sandström, whose explanation of the theory and its application in hydrography has hitherto been the only work of the kind in the English language. It is not without interest that this neighbourhood is stated to be the first to be charted by a vessel employed solely for that purpose, and that this survey was conducted by Captain Cook immediately previous to his expedition of discovery to the South Seas and the Pacific, which resulted in the addition of Australia to the British Empire.

The U.S. Coast Guard in *Bulletin* No. 14 has published a full account of Bjerknes' theory and the method of its application by Lieut.-Commander E. H. Smith, who is in charge of the scientific work carried out by the Atlantic Ice Patrol, a service inaugurated after the loss of the *Titanic* to warn vessels passing south of Newfoundland of the position of the larger icebergs, of which the Patrol follows the drift. The account is based on a series of lectures by Prof. Helland-Hansen at Bergen, and the examples by which the practical application of the theory is illustrated are taken from observations by the Ice Patrol. It is of particular interest that " the currents calculated from the observational data collected in 1922 off the Grand Banks agree very closely with the drifts of the icebergs of that same year and region " Here the method shows every prospect of being of definite and immediate economic value.

The *Bulletin* contains two handy tables from Hesselberg and Sverdrup's formulæ, to allow for the effect of pressure at different depths upon the specific volume at atmospheric pressure, a correction which becomes necessary where considerable depths are investigated, as in this area. Taking this into account, the method of calculation employed, involving the calculation of the dynamic depth, is in the opinion of the writer not so simple as that employed by Sandström—both methods yielding the same final result.

It is noteworthy that the big German scientific expedition arranged by the late Prof. Merz, which is at present engaged in a very complete investigation of the physical conditions of the South Atlantic, has planned its route in such a way as to make full use of the application of this theory in determining the currents and consequent exchange of the water masses.

It is not unreasonable to hope that this method may provide the means of investigating fluctuations in the north-going current of warm Atlantic water which bathes the western coast of Great Britain and affects our climate and sea fisheries. H. W. H.

[1] " A Practical Method for Determining Ocean Currents," by Edward H. Smith, Lieut.-Commander U.S. Coast Guard. *Coast Guard Bulletin*, No. 14. Washington, 1926.

University and Educational Intelligence.

CAMBRIDGE.—Prof. A. C. Seward, in his address on resigning the office of Vice-Chancellor, announced the offer of 150,000 dollars from the Trustees of the Laura Spelman Rockefeller Memorial for the establishment of a chair of political science. The new Vice-Chancellor is the master of Sidney Sussex College, the Rev. G. A. Weekes. The late Disney professor of archæology, Sir William Ridgeway, bequeathed to the University his collections of Stone, Bronze, and Iron Ages, including his series of barbaric currency coins, his collection of barbaric jewellery and of articles of ancient pottery.

J. D. Cockcroft, St. John's College, and J. A. Ratcliff, Sidney Sussex College, have been elected to the Clerk Maxwell Scholarship.

LEEDS.—Mr. E. L. E. Wheatcroft has been appointed to the newly created chair of electrical engineering. Mr. Wheatcroft read mathematics and engineering at Cambridge. His practical training was gained in the works of the British Thomson Houston Company and, later, with the General Electric Company in America. He has had an extensive experience in certain phases of heavy electrical engineering (particularly in regard to problems relating to the generation and transmission of power), and has carried out a considerable volume of research work.

In making this appointment the University has in mind the desirability of developing the Department of Electrical Engineering. Compared with some parts of the country, Yorkshire has followed a progressive policy in the distribution of electrical power, and it is felt that this policy should be reflected in the attention paid within the University to the study of the scientific principles of electrical engineering.

LIVERPOOL.—By the will of Mr. Samuel Turner, who died on July 18, the residue of his property is bequeathed to the University " to be applied as the University authorities in their discretion may think fit for the furtherance and advancement of medical research into the diseases of phthisis and cancer, and any kindred diseases " The bequest will apparently amount to approximately 30,000*l.* but will not be available until after the death of Mr. Turner's widow.

LONDON.—The following free public science lectures are announced :—" The Philosophic Significance of Spiritual Values," Prof. G. Dawes Hicks (at University College, October 1) ; " Is Mind governed by Laws ? " Prof. C. Spearman (at University College, October 12) ; " The Motivating of Conduct," P. Hopkins (at University College, November 4) ; " Extreme Cold," Prof. W. H. Keesom (at Imperial College of Science, October 13) ; " The Interaction of Pure Scientific Research and Electrical Engineering Practice," Prof. J. A. Fleming (at Institution of Electrical Engineers, eight, beginning October 20) , " Some Applications of Modern Science, Prof. E. V. Appleton and others (at King's College, seven, beginning October 7) ; " The Place of Mind in an Organic Theory of Nature," Prof. C. Lloyd Morgan (at King's College, three, beginning October 19) ; " Evil Spirits in Babylonian Religion," C. J. Gadd (at King's College, October 25) ; " Early Arabian Tribes," S. Smith (at King's College, December 10) ; Swiney Lectures on geology, Prof. W. T. Gordon (at King's College, twelve, beginning November 5) ; " The Present position of the Logic of Induction," Dr. C. D. Broad (at King's College, December 1).

Contemporary Birthdays.

October 10, 1871. Earl of Crawford and Balcarres, K.T., F.R.S.
October 10, 1838. Prof. W. Carmichael M'Intosh, F.R.S.
October 10, 1861. Dr. Fridthof Nansen, G.C.V.O.
October 11, 1875. Dr. Arthur William Hill, C.M.G., F.R.S.
October 11, 1864. Sir Henry George Lyons, F.R.S.
October 12, 1868. Prof. John T. Hewitt, F.R.S.

The Earl of Crawford and Balcarres was educated at Eton and Magdalen College, Oxford. Sometime president of the Board of Agriculture and Fisheries, he has been, since 1923, Chancellor of the University of Manchester. Lord Crawford is a trustee of the British Museum, the National Gallery, and National Portrait Gallery.

Prof. W. C. M'Intosh, emeritus professor of natural history in the University of St. Andrews, is about to celebrate his eighty-eighth birthday. We extend our most cordial congratulations. A fellow of the Linnean Society for sixty-three years, he will, next year, attain jubilee fellowship of the Royal Society. Born at St. Andrews, and educated at its University, his interests have ever centred and been in alliance with those of the ancient northern city. To record his long series of memoirs in zoology would absorb much letterpress. A pioneer of research in fishery problems, he was the first to found a marine biological station in Great Britain. Prof. M'Intosh was awarded a Royal medal of the Royal Society in 1899.

Dr. Fridthof Nansen, the distinguished Arctic explorer and naturalist, was born at Store Frœn, near Christiania (Oslo), at whose University he was educated, and where, since 1908, he has been professor of oceanography. In 1893 he left in the *Fram* to conduct his famous Arctic expedition. The narrative of this great polar adventure is recorded in "Farthest North" (1897). Dr. Nansen was Minister for Norway, at London, from 1906 until 1908.

Dr. Hill was educated at Marlborough and King's College, Cambridge. University lecturer in botany at Cambridge from 1905 until 1907, he was afterwards, until 1922, assistant-director of the Royal Botanic Gardens, Kew, succeeding then to the directorship on the retirement of Sir David Prain.

Sir H. G. Lyons, Colonel R.E. (retired), is a Londoner. Educated at Wellington College, he passed into the Royal Engineers. Director-General of the Geological Survey of Egypt and allied departments from 1896 until 1909, he has been, since 1920, Director and Secretary of the Science Museum, South Kensington. He is Hon. D.Sc., Oxford and Dublin. A past president of the Royal Meteorological Society, he was awarded its Symons gold medal in 1922 for services to meteorological science, in particular, investigations into the climatology of Egypt and the Sudan. His studies relative to the changes in the level of the Nile and Victoria Nyanza are well known. Sir Henry is chairman of the National Committee for Geodesy and Geophysics (International Research Council).

Prof. Hewitt, emeritus professor of chemistry in the University of London (East London College), was born at Windsor. His studies were conducted at the Royal College of Science, the University of Cambridge, and at Heidelberg.

Official Publications Received.

Transactions and Proceedings of the New Zealand Institute. Vol. 56 (New Series), July 12th. Pp. xxii+860+114 plates. (Wellington, N.Z.: W. A. G. Skinner.)

Wigan and District Mining and Technical College. Calendar, Seventieth Session 1926–1927. Pp. xvi+145. (Wigan.)

The London Schools' Guild of Arts and Crafts. Exhibition at the London Day Training College, Southampton Row, W.C.1, on Wednesday, Thursday, Friday and Saturday, September 22nd to 25th, 1926. Pp. 29+xxiii. (London.) 2*d*.

The North of Scotland College of Agriculture. Calendar, Session 1926–27. Pp. viii+124. (Aberdeen.)

Bernice P. Bishop Museum. Bulletin 24: The Geology of Lanai. By Chester K. Wentworth. Pp. 72+7 plates. Bulletin 25: Revised List of Hawaiian Pteridophyta. By Carl Christensen. Pp. 30. Bulletin 26: Fishes of Hawaii, Johnston Island and Wake Island. By Henry W. Fowler and Stanley C. Ball. (Tanager Expedition Publication No. 2.) Pp. 31. Bulletin 27: Marine Zoology of Tropical Central Pacific. By Charles Howard Edmondson, W. K. Fisher, Hubert Lyman Clark, A. L. Treadwell and Joseph Augustus Cushman. (Tanager Expedition Publication No. 1.) Pp. ii+148+11 plates. Bulletin 28: Report of the Director for 1925. By Herbert E. Gregory. Pp. 42. (Honolulu, Hawaii.)

East Anglian Institute of Agriculture (Essex Agricultural Committee). Calendar, 1926–1927. Pp. 80+xxxii. (Chelmsford.)

Department of Scientific and Industrial Research. The Building Research Station. Pp. iv+10. (London: H.M. Stationery Office.)

The Physical Society of London. Proceedings, Vol. 38, Part 5, August 15. Pp. xix+337-494. (London: Fleetway Press, Ltd.) 6*s*. net.

Medical Research Council. Sixth Annual Report of the Industrial Fatigue Research Board to 31st December 1925 (including Analysis of Published Work). Pp. iv+126. (London: H.M. Stationery Office.) 3*s*. net.

Methods and Problems of Medical Education. (Fifth Series.) Pp. iii+225. (New York City: The Rockefeller Foundation.)

The Edinburgh and East of Scotland College of Agriculture. Calendar for 1926–1927. Pp. 93. (Edinburgh.)

Memoirs of the Department of Agriculture in India. Chemical Series, Vol. 8, No. 11: Nutrients required for Growth Production with Indian Food-stuffs. By F. J. Warth and Izaz Ahmad. Pp. 211-233. (Calcutta: Government of India Central Publication Branch.) 3 annas; 4*d*.

Journal and Proceedings of the Sydney Technical College Chemical Society for 1923–1924. Edited by the Publications Committee. Vol 2. Pp. 65+7 plates. (Sydney, N.S.W.: Alfred James Kent.)

The Indian Forest Records. Silviculture Series, Vol. 12, Part 9: Notes on Artificial Regeneration in North India. By S. H. Howard. Pp. v+37+10 plates. (Calcutta: Government of India Central Publication Branch.) 1.6 rupees; 2*s*. 4*d*.

Federated Malay States. Annual Report on the Department of Agriculture, S.S. and F.M.S., for the Year 1925. By B. J. Eaton. Pp. ii+12. (Kuala Lumpur, F.M.S.: Government Press.)

Geofysiske Publikasjoner utgitt av det Norske Videnskaps-Akademi i Oslo. Vol. 4, No. 2: The Eastern North Atlantic. By Bjørn Helland-Hansen and Fridtjof Nansen. Pp. 76+71 plates. Oslo: A. W. Broggers Boktrykkeri A/S.) 12 kr.

Birkbeck College (University of London). The Calendar for the Year 1926–27 (104th Session). Pp. 226. (London.)

Journal de la Société des Americanistes de Paris. Nouvelle serie, Tome 18. Pp. xx+537. (Paris.)

Annual Report of the Meteorological Committee to the Air Council for the Year ended 31st March 1926. (M.O. 288.) Pp. 74. (London: H.M. Stationery Office.) 2*s*. net.

Scientific Proceedings of the Royal Dublin Society. Vol. 18 (N.S.), No. 26: Report of the Irish Radium Committee for the Year 1925. A Review of the Results of Radium Treatment over a Period of Ten Years (1916–1925), by Dr. Maurice R. J. Hayes; Report of One Year's Radium Work carried out in 1925, by Dr. Walter C. Stevenson. Pp. 299-327. (Dublin: Royal Dublin Society; London: Williams and Norgate, Ltd.) 2*s*. 6*d*.

Journal of the Royal Statistical Society. New Series, Vol. 89, Part 4, July. Pp. x+635–815+viii. (London.) 7*s*. 6*d*.

British Museum (Natural History). Picture Postcards. Set D9: Crystals, Series No. 1. 5 cards in colour. 1*s*. Set D10: Crystals, Series No. 2. 5 cards in colour. 1*s*. Set H3: Famous Naturalists, Series No. 2. 1 card in colour, 8 cards in monochrome. 1*s*. (London: British Museum (Natural History).)

Scottish Marine Biological Association. Annual Report 1925–26. Pp. 24. (Glasgow.)

County Council of the West Riding of Yorkshire: Education Committee. Report on the Examination for County Minor Scholarships, 1926. Pp. 31. (Wakefield: County Hall.)

Aeronautical Research Committee: Reports and Memoranda. No. 1006 (Ae. 212): Full-Scale and Model Measurements of Lift and Drag of Bristol Fighter with R.A.F. 32 Wings. By E. F. Anderson, L. E. Caygill and R. McKinnon Wood. (A. 4. a. Full-Scale Work—Aeroplanes General, 127.—T. 2169.) Pp. 5+7 plates. 6*d*. net. No. 1007 (Ae. 213): Full-Scale and Model Measurements of Lift and Drag of Bristol Fighter with Handley Page Slotted Wings. By E. T. Jones and L. E. Caygill. (A. 2. a. Calculations and Model Experiments, 107; A. 2. b. Full-Scale Experiments, 37. T. 2195.) Pp. 9+14 plates. 9*d*. net. No. 1009 (Ae. 215): Experiments on the Flow behind a Rotating Cylinder in the Water Channel. By E. F. Relf and T. Lavender. (A. 1. b. Photographic Work, etc., 10.—T. 2066 and a.) Pp. 2+6 plates. 9*d*. net. (London: H.M. Stationery Office.)

Sierra Leone. Annual Report of the Survey Department for the Year 1926. Pp. 6+1 map. (Freetown, Sierra Leone: Government Printing Office.)

Madras Fisheries Department. Administration Report for the Year 1924-25. By Dr. B. Sundara Raj. (Report No. 1 of 1926, Madras Fisheries Bulletin, Vol. 20.) Pp. iii+78+7 plates. (Madras: Government Press.) 14 annas.

the International Catalogue has scarcely been used at all by chemists. Chemistry, however, is exceptional; some other sciences are far less well served, and unless the societies concerned, or private bodies, intend to undertake the work of abstracting or of compiling bibliographies in a comprehensive way, there appears to be scope for an international effort of this kind.

Related to this subject of abstracts is that of the use of scientific and technical libraries. We greatly appreciate the action of those learned societies which open their doors to students and to others who are not members. For example, in 1919, as a result of a conference of chemical and allied societies, the Chemical Society extended the chemical equipment of its library and admitted as readers the members of the Association of British Chemical Manufacturers, the Biochemical Society, the Faraday Society, the Institute of Chemistry, the Society of Chemical Industry, the Society of Dyers and Colourists, and the Society of Public Analysts. The effect of this wise policy is partly shown in the number of books borrowed during the year. This has risen from 2905 in 1918 to 4050 in 1925. During the year 1925, there were 6994 attendances of readers in the Library of the Chemical Society, of which 4746 were made by fellows and 2248 by members of contributing societies.

There is, of course, a difficulty in opening the doors of a library too widely: there may not be seating accommodation for all who would come in. As time goes on, many scientific libraries find their shelves fully occupied and are at a loss to know how to provide room for the new volumes.

Some libraries contain many volumes they do not really need which would be much more appropriately placed in some other institution. The Association of Special Libraries will be doing good work if it takes this matter in hand and induces each library to exchange or dispose of such works as it does not need and thus make room for books or periodicals more directly connected with its own special subject.

It is by no means desirable that all the older scientific books should be destroyed on the ground that they are out-of-date, for many of these books are valuable historical evidence of the state of scientific knowledge and theory at the time they were written. Indeed, some of them contain original observations which have since been overlooked. But provided that it was assured that a certain number of copies of these works would be preserved, the remainder might cheerfully be removed.

The Association of Special Libraries is not, however, concerned alone with the use of books: its object is "to facilitate the co-ordination and systematic use of sources of information in science, industry, commerce, public affairs, etc." It was appropriate, therefore, that in a paper entitled "A National Intelligence Service," Mr. J. G. Pearce should raise the question as to what is the most efficient method by which scientific and technical workers throughout the country may receive early information about new discoveries and new developments in the subjects with which they are concerned.

A central institution of the kind would have classified index-cards, each bearing the full reference to a book or paper, with a summary of its contents. When it is remembered that some 24,000 periodicals which may contain scientific articles are published throughout the world, and that to this number pamphlets and books must be added, it will be seen that the number of index-cards required to be prepared every year would be very large, probably at least a quarter of a million. The work of selection and indexing must be done by experts in each subject, and then the cards must be written, typewritten, or printed. When an inquiry was received, the staff of the institution would look up the index-cards bearing upon the subject, and would send copies of these, obtained either by typing or by photography.

The Association proposes to make use of the special libraries and information bureaux which already exist in Great Britain. There are several hundreds of these, including the libraries of learned societies, universities, colleges, public libraries, libraries of research associations and libraries of manufacturers and business firms. The first step is the preparation of a Directory of Special Libraries in Great Britain and Ireland. The general editor for this Directory is Mr. G. F. Barwick, late keeper of printed books at the British Museum, whose name is a guarantee that the work will be well done. It is hoped to publish the directory in the summer of 1927. Such a directory will indicate the library or libraries where information on a given subject is likely to be found. Apart from this directory, the Association proposes to answer inquiries from its members as to the literature on a particular subject by giving the names of those libraries that are likely to be able to give the information required.

There are divergent opinions concerning the desirability and practicability of special scientific libraries undertaking the work of information bureaux. Libraries undertaking this work would require greatly enlarged staffs. Information-hunting is a long and arduous pursuit, and we are informed by two experts in this business that the average time required to answer a single inquiry is about two days. On the other hand, the expense should not be prohibitive, for, as Dr. de Vos remarked, an information service should be made to pay for itself: firms and individuals could

afford to pay high fees if they were relieved from doing the work themselves. A second difficulty would be to find the personnel. Information work demands very special qualifications, both in regard to knowledge of books and other sources of information, of at least one science, and a natural *flair* for finding things out. Special training might solve this difficulty to some extent, and a real demand would probably create a supply. Large firms and institutions would, however, probably continue to employ their own information officers, so that the work of information bureaux set up in connexion with special libraries would consist mainly in serving the needs of individuals and small institutions. A further hindrance to the realisation of the scheme would be found in the inability of scientific libraries owned by learned societies to undertake work for outside firms and individuals; charters of incorporation would have to be carefully scanned before action was taken.

The language difficulty is a perennial one in the sphere of the dissemination of scientific knowledge, present methods being prodigiously wasteful in time, effort and money. Translators who possess the qualification of expert knowledge of science and language, including its idioms and technical terms, are exceedingly rare, and as a rule the work is badly remunerated. At the Oxford meeting, Mr. P. K. Turner, of the Research Department of Burndept Wireless, Ltd., spoke in no exaggerated terms of these difficulties, and his suggested solution the adoption of an international auxiliary language—though old, is one that cannot be overlooked.

Following closely on the lines of the International Auxiliary Language Committee of the British Association, Mr. Turner considered the rival claims of a dead language, a modern national language, and an invented language, and came to the conclusion that Latin is too difficult for the purpose, a modern language would inevitably raise international jealousies, and that an invented language, easy to learn, precise, and capable of providing new words for new concepts, would be best. Of the artificial languages now current, only Esperanto, its offshoot Ido, and Interlingua (Latin without inflexions) are of serious importance, and of these Esperanto has undoubtedly made the greatest headway. We have recently read a scientific treatise on the elementary principles of radio-communication written in Interlingua, the language sponsored by Prof. G. Peano, of the University of Turin, and were much impressed by its ready intelligibility and its brevity; but probably any of the three languages named would serve, with or without modifications, for international abstracts and bibliographies.

The fact remains, however, that none of these invented languages has made any progress in the scientific world. Whenever they are suggested they seem to raise a perfect *furore* among partisans of the dead and national languages. We hold no brief for any one of these linguistic devices which, like shorthand, mathematical, chemical and musical notations, have been invented to serve a special purpose, but in view of the very great advantages that would follow the adoption of a suitable medium for international communications in science, we think that the subject should not be allowed to drop. If the world were ruled by reason (which it is not, and probably never will be) an international auxiliary language would have been adopted many years ago; it remains to be seen how far civilisation will succeed in promoting the dictates of reason against the opposition of instinctive tendencies and age-long prejudices.

Propaganda and Philosophy.

(1) *The Gist of Evolution.* By Prof. Horatio Hackett Newman. Pp. x + 154. (New York: The Macmillan Co., 1926.) 6*s*. net.

(2) *Selected Articles on Evolution.* Compiled by Edith M. Phelps. (The Handbook Series.) Pp. liii + 283. (New York: The H. W. Wilson Co.; London: Sir Isaac Pitman and Sons, Ltd., 1926.) 2.40 dollars.

(3) *Science as Revelation.* By John M. Watson. Pp. 303 + 7 plates. (New York: The Macmillan Co., 1925.) 10*s*. net.

(4) *God and Evolution.* By the Rev. W. R. Matthews. (Liverpool Diocesan Board of Divinity Publications.) Pp. ix + 58. (London: Longmans, Green and Co., Ltd., 1926.) 3*s*. net.

So far as one can see from current apologetic literature, England and America present rather a strong contrast. The religious problem across the Atlantic seems merely to be the limited one of evolution *versus* the book of Genesis, an issue which engaged the attention of Englishmen half a century ago, when Americans were getting over their disastrous civil war. The three volumes from America before us all deal more or less directly with the Fundamentalist controversy, the seriousness of which is not understood in England, where we are inclined to laugh at it. It is, however, no laughing matter. It is already being converted into a political issue; the "Bible Schools" where non-graduates are trained for the ministry are engaged in an industrious propaganda, and in some places no political candidate would stand a chance of election who did not profess 'Biblical' views, and no teacher in a public institution could retain his position if he favoured evolution.

(1) In his volume, Prof. H. H Newman, who

participated in the Scopes trial, contributes a brief and clear statement of modern biological doctrines, written for popular use and avoiding technical language so far as possible. The late Lord Acton somewhere tells a story of a great medical specialist unable to pronounce definitely upon a case brought to him. As a clear plain verdict was insisted on by the patient's friends, the great man replied: "I cannot tell you myself, but I can recommend you to fifty doctors who would." The fact is that ignorance can always be dogmatic, and this is where the conscientious man of science is at a disadvantage. "The chemist, the astronomer, the geologist, equally with the biologist and the physicist, feel the inadequacy of their present knowledge of their subjects," writes Prof. Newman. The Fundamentalist has no such searchings of heart, and his omniscience is a controversial asset. Still, we may hope that Prof. Newman's "Gist of Evolution" will be read and pondered by intelligent people in America. It is admirably lucid, its topics are well chosen, and it is neither heavy nor verbose.

(2) Miss E. M. Phelps's book is a compilation of carefully selected articles on evolution, expressions of opinion on both sides of the controversy being included. We cannot imagine anything more useful for one anxious to get a clear grasp of the issue. Although a number of these articles might be selected for attention, that of Prof. John Dewey strikes us as peculiarly valuable as a diagnosis of the situation. It appeared in the *New Republic* of April 2, 1924. He points out that whereas in times past there were two parties to a dispute of this kind, *i.e.* the theological and the scientific specialists, nowadays there is a third, the general public. The real issue now "concerns the growing influence of the general public in matters of thought and belief, and the comparative failure of schooling up to the present time to instil even the rudiments of the scientific attitude in vast numbers of persons, so as to enable them to distinguish between matters of mere opinion and argument and those of fact and ascertainment of fact. . . .

"The realities of the situation centre about what can be done to ally the forces which have democratised society with the mental and moral attitudes of science. The worst of the predicament is a tendency towards a vicious circle. The forces that compel some degree of general schooling also make for a loose, scrappy, and talkative education, and this education in turn re-enforces the bad features of the underlying forces."

(3) These remarks seem applicable to the third volume under review. Mr. J. M. Watson's "Science as Revelation" is a book of rather ambitious scope, attempting to put in clear, brief, and popular form the results of research in all the sciences from physics to psychology. There follow two chapters on ethics and philosophy, and then two more on the new religion, and the new revelation, of science. We are inclined to think that so far as religion and ethics are concerned, our author unduly simplifies the problems. The real issues, namely, as to whether biological science does supply us with an enlightened ethic, and whether the cosmic process is for us or against us (as Huxley taught), he does not seem to face. He sometimes covers up the difficulties with rhetoric, as when he tells us that "Truth is the ONE GREAT GUIDE, and he who closely adheres to it cannot possibly go wrong." Surely this is prolix nonsense: for what the truth is about these matters is just what we would like to discover. Mr. Watson evades the real religious problem, which is not: Does God exist? but, What sort of a God exists? The book seems to us to preach a sort of inverted Fundamentalism; it strikes us as well-intentioned but shallow.

In England, as was observed above, the Genesis *versus* science issue has retired into the background. This may be because there exists a higher level of general education and intelligence in this country; or it may be that amongst ourselves the general public takes little interest in religious problems, so that they are left to the experts who naturally treat them with more intelligence. Between these alternative explanations, we hesitate to pronounce. At any rate, in reading Dr. Matthews' book (4), we breathe a different air; the atmosphere of embittered polemics is absent.

This does not mean that Dr. Matthews sees no important difference between the views he himself holds and those held by some evolutionary philosophers and men of science. He devotes a certain amount of attention to Mr. H. G. Wells and Mr. Bernard Shaw; but, as he says, "there is no arguing with prophets," and we are relieved when he turns "to the less inspiring but more coherent writings of systematic thinkers." His treatment of Prof. Alexander interests us most. There has always seemed to us a difficulty, or even an inconsistency, in the views of this highly original thinker. He asserts that there exists in the universe a tendency, or 'nisus,' to produce a series of qualities of existence; a series like a hierarchy of values which increase as the process continues. We have matter, life, mind, and, in due course (we may hope), deity. But there is no 'purpose' or plan behind this. The elements of the series just 'emerge'; and we must accept their 'emergence' with 'natural piety,' *i.e.* with a devout agnosticism. But what *is* this 'nisus'? Is it just a word to signify that the world is so constructed that, as a matter of fact, it does produce what 'emerges' (in which case the word really has no meaning)? Or does it signify that there is an 'urge'

in the universe which makes it creative? If so, we have got something indistinguishable from 'purpose.' Prof. Alexander is too clear a thinker to talk about 'unconscious purpose,' which is a contradiction in terms, and he prefers not to use the word at all. But 'nisus,' if it means anything, must end by meaning this.

Dr. Matthews seems to us at his best when engaged in philosophical criticism. We doubt if many biologists would follow him in attaching much importance to the views of Driesch, and although all the world recognises the debt which physiology owes to Dr. J. S. Haldane, few take his vitalistic theories seriously. The tendency now is clearly and strongly in favour of mechanistic interpretations. One strong point in Prof. Alexander's work is that he recognises this. We doubt if Dr. Matthews strengthens his case by patronising obsolete scientific theories. The most damaging criticisms of naturalism come from insistence on "the difficulties which inhere in any philosophy which excludes all idea of a supra-temporal reality" (p. 37). As a philosophical system, evolutionary naturalism is beset with difficulties: as a religion, it "is founded on as great an act of faith as any which the Christian doctrine of God requires of us." How true this is—but how unpopular!

We may hope that many students of science, as well as students of theology, will peruse these lectures. They are of a very high quality. We should like to wish them a good circulation in America as well as in Great Britain, when the contagion of Fundamentalist frenzy has passed.

J. C. H.

The Races of Mankind.

(1) *Les races et les peuples de la terre.* Par Dr. J. Deniker. Deuxième édition revue et considérablement augmentée. Pp. 750. (Paris: Masson et Cie, 1926.) 75 francs.

(2) *Race and History: an Ethnological Introduction to History.* By Prof. Eugène Pittard. (The History of Civilisation Series.) Translated by V. C. C. Collum. Pp. xxiii + 505. (London: Kegan Paul and Co., Ltd.; New York: Alfred A. Knopf, 1926.) 21*s.* net.

THE reluctance of anthropologists whole-heartedly to apply to the human family the strict principles of classification and phylogenetic arrangement adopted in the wider field of biology is a very curious phenomenon. Yet it is a fact that students of man, even biologists, commonly disregard the significance usually associated in biology with such terms as race and species; and even when this element of confusion is eliminated there still remains some uncertainty as to what constitute the criteria of race. Many years ago Huxley humorously claimed exemption from the disturbing influence of race consciousness that so obviously distorts the outlook of many, if not most, writers on anthropology, on the ground that he enjoyed the serene impartiality of a mongrel.

This factor of personal or racial bias has been a potent factor in causing confusion in the study of race. When, early in the nineteenth century, efforts were made to emancipate the Greeks from Turkish rule, ethnology was used as a political instrument. Ever since then scarcely any national or social conflict anywhere in the world has been free from anthropological irrelevances, which have had the disastrous effect of hampering the calm and dispassionate study of a subject that teems with intrinsic difficulties. One has only to recall the distorting effects of such national prejudice in the claims for Teutonic ascendency and the northern origin of civilisation, the conflicts associated with the phrases 'Yellow Peril' and 'Nordic Race,' and the ever-present antagonism between black and white in the United States, to realise how scientific impartiality has been warped.

Even when such influences are exorcised, two other disturbing factors remain. There is first the selection of the qualities to be used in the determination of race and the estimation of their relative value. Secondly, the factor of racial admixture must be given due consideration by making allowance for its effects. The chief element of confusion in the definition of human races has been due to the former factor, and especially the lack of a due sense of proportion. Examples of this are the exclusion of Bushmen from the Negro race because their skin is not black, suggesting a close affinity between aboriginal Australians and Europeans because there are similarities in the hair, or between Negroes and Mongols because they both have flat noses. But perhaps the most potent element of confusion is the persistence of the term Caucasian, which involves the failure to accord adequate recognition to the fact that there are at least three definite and distinct races, commonly called Mediterranean, Nordic, and Alpine, in the population of Europe and western Asia. Even when the six easily differentiated races—Australian, Negro, Mongol, Mediterranean, Alpine, and Nordic are recognised, there still remains the problem of assigning to each its degrees of affinity to the rest. This can only be done by devising a tentative phylogenetic tree to indicate which races are primitive and which are specialised or advanced.

No work has yet been published that deals with the question of race in such a way as to give adequate recognition to these principles, but the books by Dr. Deniker and Prof. Pittard make a serious attempt to introduce some sort of order and a right perspective

into these questions and to deal with the problems of race in a strictly biological way. They also emphasise the need for caution—never more necessary than at the present time—of not confusing race with culture, language, political aptitude, or distinctive moral qualities.

(1) Of the works dealing with the whole world, perhaps the sanest and the best-balanced is that written in 1900 by the late Dr. Deniker, the learned librarian of the Natural History Museum in Paris. By dealing with both race and culture in intimate association one with the other, he was immune from the sort of errors which writers are liable to commit when they deal with only one aspect of anthropology and neglect the other. Another factor that enhanced the value of Dr. Deniker's book was the information derived from Russian and other Slavonic literature, which is a sealed book to most western anthropologists. At the time of his death in 1918 he was engaged in the task of preparing a revised and considerably enlarged edition of his excellent book. With the help of a number of his colleagues in Paris the author's family has just brought out this new edition after a lapse of eight years. During this time anthropology has made great strides. Hence this book can scarcely be regarded as quite up-to-date. Nevertheless, the improved edition of a book which for more than a quarter of a century has been the standard text-book on the subject is most welcome.

(2) In his foreword to Prof. Pittard's book, M. Henry Berr tells us that in 1912 Dr. Deniker promised to write a volume on race and history for the series of monographs he is editing under the title " L'Évolution de l'humanité " (which is now being issued in English under the general title " The History of Civilisation "). On the death of Dr. Deniker he entrusted the task to Prof. Eugène Pittard, of the University of Geneva, who is well known as an industrious and careful worker in physical anthropology, especially of Switzerland and the Balkan area.

The book is not a treatise on race, nor does it deal in the strict sense of the term with history. It is rather a series of essays on some of the more contentious problems in which factors of race came into some relationship with history. The method of treatment is cautious, if not elusive. In fact much of the book is written in the form of questions to which the author gives no decisive answer. Here is a typical example of Prof. Pittard's method of exposition :

" The abuse of the influence of physical environment as the principal determinant of variations in man reveals to us another attempt at facile explanation in the application of the law of minimum effort. What has not been solemnly put down to it ? With what assurance has it been sought to convince us that environment is everything, that men are eminently plastic beings, submitting without protest to every sort of influence ! No single character could resist the moulding hand of environment, that all-powerful sculptor who, just as education renders our intellect and moral character rigid, petrifies as with a glaze our different morphologies. Has not the influence of environment been invoked to explain the anatomical variety seen in Jews, thenceforward acquired by very reason of such influence ? Does not the morphological Americanisation of various European immigrants in America call, on certain points, for all reserve on our part ? What mechanism other than hybridisation could environment employ to mould the cranial character of the new Americans ? No one is able to tell us." (P. 14.)

This quotation is typical of the style and method of the book as a whole. Two-thirds of the volume are devoted to Europe. The remaining third deals with Turks, Phœnicians, Jews, Arabs, Iranians, and Tatars, with brief essays on the peoples of India, China, Japan, Egypt, Mexico, the Malay Archipelago, and Oceania.

The book as a whole is a welcome corrective to much that is misleading and confusing in modern anthropological literature. Prof. Pittard does occasionally relent from his attitude of cautious avoidance of direct expression of his views. On most of these occasions he reveals a very conservative adherence to the opinions generally held by French anthropologists, and in particular by Prof. Boule. Thus he accepts without question the opinion that the figurines of the so-called Upper Palæolithic, so misleadingly described as steatopygous, afford evidence of the former presence of people of Hottentot affinities in Europe, a fallacy that Prof. Verneau justly exposed in his Huxley Lecture to the Royal Anthropological Institute in 1924. But Prof. Pittard also adopts Prof. Boule's theory that Verneau's Grimaldi race is really negroid and affords corroboration of the Hottentot speculation ! Having recently examined the two skeletons from the Grottes des Enfants at Monaco, I am convinced that there are no just reasons for calling the 'Grimaldi race' negroid.

Prof. Pittard pours gentle scorn on the recent campaign in favour of the supremacy of the Nordic race. Nevertheless he ironically says that the

" despised brachycephals, these representatives of the inferior race *Homo alpinus*, would seem to have invented and propagated two things of capital importance to the progress of civilisation. It is to them that we probably owe the culture of cereals and animal domestication, and that is by no means a small contribution. It might even be said to outweigh a certain number of raids and massacres. Did not these inventions, indeed, have a larger part in determining social progress, and for a longer time, and was not their influence of wider extent than all the warlike disturbances of the Northerners put together ? "

There are, however, no valid reasons for assuming that the Alpine people did invent these fundamental contributions to civilisation. At the meeting of the Australasian Association for the Advancement of Science in 1921, Prof. Thomas Cherry set forth evidence establishing the fact that it was members of the Mediterranean race who made these inventions (see also NATURE, June 10, 1920, p. 474).

The problems of determining the ancestry and the original home of the human family, and whether men everywhere spontaneously invented the Chellean *coup de poing*—which Prof. Pittard calls the hypothesis of prehistorians—are brushed aside in two pages of provocative queries, none of which are answered. Instead of this Prof. Pittard says "an attitude of doubt is the wisest." "If an answer must be given to the question put, we shall have to be honest and say that we do not know."

The book affords an amazing revelation of the extent of the misconceptions concerning the Piltdown skull still entertained on the continent. The Piltdown cranium reveals a closer approximation to the condition found in the young chimpanzee than any other human skull does. Yet Prof. Pittard tells his readers (p. 56) that it "would seem to indicate a more highly evolved race" than Heidelberg man. But he goes further than this when he suggests

"the possibility of the Heidelberg race having given birth to the Piltdown race, and the Piltdown race of the type with progressive characters which we meet with in Aurignacian times."

In spite of these defects the book is valuable and interesting. If it adds a few more misunderstandings to the literature of anthropology, it more than atones for this by helping to remove a host of others.

In her translation Miss Collum has wisely kept as near as possible to a strictly literal version of the French. If at times the idiom is uncouth, it enables the reader to realise exactly what the author wrote in a highly controversial subject. The word 'humanité' would be more correctly rendered into English by 'mankind' and not by 'humanity.' The word 'peninsula' is wrongly spelt throughout the book. In fact both in Deniker's and Pittard's book there is an unusually large series of typographical errors.

G. ELLIOT SMITH.

The Influence of Science.

Science and Civilization. Essays Arranged and Edited by F. S. Marvin. (The Unity Series, 6.) Pp. 350. (London: Oxford University Press, 1926.) 6s. net.

RATHER more than nine centuries ago, Avicenna bestowed the title of "The Remedy" upon his great treatise on natural philosophy. It is not difficult to appreciate the meaning which lay behind the choice of this unexpected name: natural philosophy, or simply science as we prefer to call it now, was in Avicenna's opinion the cure for the manifold ills of mankind and a tonic to brace humanity for the future. The natural supplement to this opinion is Comte's statement *Savoir afin de prévoir*, which is the motto of the present book. It is now three years since "Science and Civilization" was first published, and because, amid the flood of ephemeral literature which issues from the innumerable presses of the world, those books which are of lasting value run a grave risk of being swept away, we are grateful to Oxford for this new and cheaper edition. The essays which Mr. F. S. Marvin has here edited are, indeed, so valuable and so inspiring that we could have wished for an even less expensive edition: six shillings, though a modest price for a book in these days, is still too much to allow of that wide diffusion which all of us would like to see in the present instance.

No one can feel satisfied with the results which the widespread teaching of science in Great Britain has so far produced. The majority of men appear not to have retained the merest fragment of the scientific facts they presumably learnt at school, and they certainly show no sign of having assimilated scientific principles and method. Even among men of science themselves it is not rare to find science regarded as a craft rather than as a philosophy, and a successful chemist or physicist is often on no higher an intellectual level than a skilled motor mechanic. In these circumstances, science will still advance so long as destiny throws up from time to time the man of insight and genius—the Dalton, the Clerk-Maxwell, the J. J. Thomson—but is that progress likely to be as thorough or as rapid as would be desirable? Is it in the least degree probable that the intellectual advance of the nation at large will keep pace with even a comparatively slow advance of science if present conditions continue? It seems that the answer to both these questions must be a regretful "No"; whereupon the further question arises: What will be the effect upon civilisation if the general intellectual level lags seriously behind the progress of science? In the last year or two this question has been discussed by several talented and imaginative novelists, philosophers and men of science, but we may draw a lesson from the past—the mobilisation of scientific resources for purposes of wholesale destruction during the War showed us only too well what fate may lie in store for the world if the powers and forces of science are misapplied.

It is a common plea that men of science, collectively, are not responsible for the evil uses to which mankind may put scientific knowledge, but is not the argument

fallacious? A man who invents a new weed-killer and leaves it lying about, so that his child poisons himself with it, cannot be absolved from blame on the score that his invention was wrongly applied. If a chemist produces a tremendously effective explosive, fully realising that in all probability the first use men will make of it will be to destroy one another, it is very difficult to acquit him altogether. Read this extract from an account of the Spanish operations in Morocco: "Like the fiery rain of Dante, the bombs crashed from the skies, smashing villages, burning crops, slaying the wounded and murdering women and children. . . . For these bravos of the air there were not even the usual sporting risks of war—no fearless hostile airmen to grapple with; no anti-aircraft guns to face. A good breakfast, a pleasant ride, a few brave men killed, a few children rendered homeless and orphans—then back to a good dinner." Has science, which made things like this possible, no responsibility? Am I my brother's keeper?

In a certain sense, of course, science is non-moral, and in the illustration given above it is clear that the wrongful action lay not in the invention of the weed-killer but in the carelessness which left it unguarded. Science *qua* science is not responsible for its misuse, and we are perfectly justified in insisting upon this when the opponent of progress points to the ruined village, the slave of cocaine or the blinded victim of the vitriol-thrower. It is, however, impossible to divorce science from the scientist, and the latter is human and shares human responsibilities. To adopt a sentence of Dean Inge's in a sense different from that in which he used it, "we must not regard the world of science as an objectively existing fact, wholly independent of us who observe it." The scientist, in fact, has a double duty: he must not only further the course of science but must also do his utmost to ensure the right use of the control of Nature he places in men's hands.

Such books as "Science and Civilization" are eminently serviceable for the latter purpose, since they make the unreflective man of science reflect and at the same time manifest to the general public, in a way which more technical books could not, what Sir Richard Gregory has happily called the "Spirit and Service of Science."

Of all the good things which Mr. Marvin has collected for us it is difficult to single out any particular essay for special mention, but the attention of all who are engaged in teaching science—whether in universities, colleges, or schools may be earnestly directed to the essay on "Science and Education." For the root of the whole problem appears to us to lie in the way in which science is taught, and more especially in the way in which it is taught in our schools. Mr. Heath's thoughtful study should be read by every schoolmaster, whether a science master or not, and although his warm approval of the methods of Sanderson of Oundle may leave some of us cold, all of us will realise better than we did before the magnitude of our responsibility and of our opportunity.

The essays which deal with the history of science in its social aspects are still, as when first published, the best of their kind; they show that a true internationalism, which the League of Nations is laboriously striving to effect in the world of politics, has already and for centuries past been effected in the world of science. Scientific internationalism, superior to but not destructive of local patriotism, affords the best safeguard for the future of civilisation, and Mr. Marvin and his collaborators have the solid satisfaction of knowing that they have made a not insignificant contribution to this end.

E. J. HOLMYARD.

Modern Industrial Chemistry.

(1) *An Introduction to Industrial Chemistry.* By Dr. S. I. Levy. Pp. xiii + 288 + 16 plates. (London: G. Bell and Sons, Ltd., 1926.) 15*s.* net.

(2) *Industrial Chemistry: a Manual for the Student and Manufacturer.* Edited by Allen Rogers. Fourth edition. In 2 vols. Vol. 1: Inorganic. Pp. xx + 511 + xxiii. Vol. 2: Organic. Pp. iv + 512-1267. (London, Bombay and Sydney: Constable and Co., Ltd., 1925.) 52*s.* 6*d* net.

(1) IN his introduction to industrial chemistry, Dr. Levy presents an aspect of a branch of technology which is not usually portrayed in treatises dealing with the application of chemical principles to factory operations. The new departure consists in directing special attention to the utilisation of all factors involved in efficient large scale production, these essential factors being grouped under the heading of "Costing."

As a typical example the author selects the manufacture of aniline from such commercially available materials as benzene, sodium nitrate, sulphuric acid, and iron filings. The factory method of keeping stock accounts of raw materials, intermediates, and final product is illustrated. Plant record sheets and overall consumption figures are also computed and furnish data for the tabulation of a flow sheet showing the efficiency of the process at each stage. The cost price of the final product is determined by drawing up a cost sheet, taking into account not only the price of materials but also overhead charges and the cost of various services. The exact incidence of the separate items on the cost of production is readily revealed by expressing these data in simple graphical form.

Following on this concrete example of the importance of process costing, the author deals with such typical large scale operations as heating and cooling, pulverising, mixing, filtration, extraction, distillation, sublimation, and desiccation. A short section is devoted to the works equipment required in the storage, transportation, and manipulation of gases, liquids, and solids.

A general survey of chemical industry condensed into 40 pages is so sketchy that it is of doubtful utility and detracts from the merit of a treatise which otherwise sets up a new standard of excellence among technological text-books. A similar criticism applies to the short chapter on the fuel industries.

To the topic of sulphuric acid, however, an authoritative chapter is devoted which contains valuable details and includes the author's war experiences as shown by the data then collected in regard to the relative costs of production of sulphuric acid by the chamber process and by the various contact processes. The concluding sections deal with the alkali industry and with the manufacture of intermediates and explosives. The economic factor is again emphasised and flow sheets are appended giving the costs of production of the principal service explosives.

As indicated by Sir William Pope in his introduction to this volume, the treatise is modelled on unconventional lines and may accordingly be read with advantage by every one interested in the industrial applications of chemistry.

(2) These two volumes are the fourth edition of a comprehensive manual written by a group of American chemists and covering a wide range of industrial topics.

Vol. 1, which deals mainly with inorganic subjects, commences with a chapter on general processes as carried out in the factory; but sometimes, as in the case of autoclaves, the information given is only slight. Water for industrial use, a matter of general interest, receives attention in a separate chapter having its own bibliography. A very readable essay on sulphuric acid contains interesting details, especially in regard to American practice, but English readers will be surprised to find no mention of Messel and his associates in the survey of the historical development of the contact process.

A chapter on elements and compounds, arranged alphabetically, contains references to these materials which are sometimes misleading and generally too fragmentary to be of any practical value. Cobalt is dismissed in a few lines as colour producing element, but its increasingly important alloys are not mentioned. Under the heading of hydrogen peroxide there is no reference to the concentrated forms of this oxidising agent. The statement that sodium nitrite is prepared by heating sodium nitrate and metallic lead refers to an unhealthy process which happily has become obsolete. Altogether this section on elements and compounds is a hopeless attempt to compete with the larger chemical encyclopædias.

Ozone is discussed in the foregoing section and again in the section on electro-chemical industries, so that in future editions the editor might well consider the desirability of having a separate chapter on the atmospheric gases, including in this section oxygen and ozone.

The second and larger volume of this treatise contains instructive essays on various industries based on organic chemistry. The products of the distillation of coal are discussed from different viewpoints in several chapters, and the destructive distillation of wood is the subject of a separate section. In view of the increasing production of synthetic methyl alcohol, a chapter might appropriately have been added on this alcohol and its derivatives, including formaldehyde and its industrially important condensation products. The section on explosives is too short to be of value for reference purposes, and the following statement is misleading (p. 1183): "Titra-nitroaniline (*sic*) made by nitrating aniline." The patented nitration starts from *meta*-nitroaniline prepared from dinitrobenzene.

There are, however, many excellent monographs in this organic section, and among them may be mentioned the informative articles on essential oils, perfumes, and flavouring materials, on resins, gums, and turpentine, and on leather.

What is Mind?

Mental Life: an Introduction to Psychology. By Dr. B. Edgell. Pp. xvi+275. (London: Methuen and Co., Ltd., 1926.) 7*s*. 6*d*. net.

PSYCHOLOGISTS are faced with the difficult task of clearly distinguishing their field of study, on one side, from philosophy and, on the other, from biology. The domains of other sciences were originally defined in naive, common-sense terms that raised no initial difficulty. On the basis of common experience every one knew what was meant by 'heat,' but with its scientific study, unexpected difficulties arose. The 'caloric' proved weightless, and 'heat' was then described as a mode of motion. The facts of radiation raised fresh difficulty, and theory gave, first, 'insensible heat' and then motion of an immaterial ether. This entailed the difficulty of a kinetic energy from which the term mass had vanished: to be dealt with in turn by recasting the meaning of energy in the light of electro-magnetic theory and the theory of relativity.

Still, however, the definition of 'heat' presents difficulties which are but evaded in the modern tendency to fall back on some reference to crude introspective evidence and common-sense belief such as: 'The agent which produces in us certain sensations.'

Put 'mind' in place of 'heat' and just because 'mind' is of greater interest we find that, before the days of experimental science, it had been so studied that the problem of its ultimate nature had already reached the almost hopeless position in which 'matter' and 'electricity' now find themselves. Modern psychologists are tempted to benefit by the experience of experimental science and leave to philosophy their ultimate problem. Not—What is mind? but—What are its activities? seems problem enough Psychology becomes the "science of mental life" (p. xi).

'Life' however is as elusive as 'mind.' Biology disowns the problem of 'life' and is content to be the 'science of living things.' Possibly, shorn of all that is best left to metaphysics, nothing remains of a 'science of mental life' that is not well within the purview of the 'science of living things'! Accept this conclusion and psychology becomes the 'science of behaviour.' But the crude facts of mental activity are known to every one, and even medicine has found in *mental* sickness, as opposed to *organic* lesion, the easiest explanation of certain forms of bodily incapacity. Explanatory theory in terms of 'unconscious mental activity' follows and leads the way into highly speculative regions of 'new psychology,' in which an attempt is made to supply the need felt of an abiding something that, through all changes, continues. Psychology becomes the 'science of the unconscious.' Physics in similar straits formulated the theory of the ether.

As a result of this difficult position, many an 'introduction' to psychology, after a few words on the foolishness of 'the old psychology,' reveals itself as concerned only with some particular modern development or school of thought It is therefore refreshing to meet a work that is entitled to its claim: an introduction to *psychology*. With clear knowledge of the 'old,' Dr. Edgell has reviewed much of the 'new' and given it its place in that evergrowing body of knowledge in the formulation of which Aristotle played no unimportant part.

The general line of treatment follows James and Ward and brings their work up-to-date with new facts and theories that have taken sufficiently definite shape to be presentable in form suitable for the general reader and beginner.

Controversial matter has of necessity been included, and psychologists will welcome the author's statement of position on 'Freudian theory' and 'behaviourism.' Considering the theories of Freud, Adler, and Jung, she writes: "All attempts to reduce primitive values to one inclusive category seem futile, for, even when combined, these three types of appeal may be far from exhausting primitive possibilities" (p. 157). Then, dealing with Freudian theory in more detail, "It may well be that, notwithstanding the success attendant on psycho-analysis, the unconscious as conceived by Professor Freud, is a 'false cause' . . . the Freudian theory appears to conflict with any intelligible view of mental life" (p. 160).

In opposition to the narrow Freudian view of 'the unconscious' the author uses the term for the "organisation of meanings and values (knowledge and character) . . . the abiding structure of mind" (p. 158). This leads to interesting corollaries including apparently a disavowal of the fundamental Freudian belief in unconscious mental activities (p. 173).

Behaviourism is reviewed in an appendix. The inadequacy of the experimental basis to support the deductions drawn therefrom is stressed. Really to secure the behaviourist position "conditioned reflexes should be established in circumstances where there is reasonable evidence of the complete absence of what the psychologist calls consciousness" (p. 265). Behaviourism "breaks down as a system of psychology and is no more successful in shelving the problem of mind and body than was its precursor, epiphenomenalism" (p. 268).

The definition 'science of mental life' also attempts to shelve the difficulties surrounding the idea of mind as an abiding entity (p. xi), but leads to a position almost identical with that of James when he wrote: "The thoughts themselves are the thinker." "We must be on our guard," writes the author, "against treating . . . the subject or individual experient [as if he] were something over and above his experience" (p. 19). We find difficulty in attempting to harmonise this with the 'unconscious' as "an organisation . . . the abiding structure of mind" Then we realise that much of the book is concerned with this 'structure' rather than with 'experience,' and reading, "This structure is being built up by the events of mental life; in its turn it determines the function of mental events, their meaning and their value" (p. 126), we again grow hopeful that it will yet be possible for psychologists to follow Prof. McDougall back to the definition 'science of mind' as the best to cover both "facts of mental activity and facts of mental structure" ("Outline of Psychology," p. 41). In such a definition any particular theory of the ultimate nature of mind is no more posited or necessary than were theories of the ultimate nature of electricity and matter in the original definitions of the fields of study of the physicist and chemist.

R. J. BARTLETT.

Letters to the Editor.

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Spectrographic Junction between the X-ray Region and the Extreme Ultra-Violet.

IN previous papers (*Comptes rendus*, **182**, 1083, and **183**, 193, May and July 1926) a method was given, suitable for spectrographic work in the unknown region between 20 and 150 Ångström units. In the meantime, some $K\alpha$ lines belonging to light elements (oxygen, carbon, boron), and a few N barium lines, have been measured. It was interesting to apply the new method to the detection of lowest frequency N and O series of a heavy element. Thanks to the kind help of Dr. Holst, Director of the Philips Laboratory, I obtained a sample of thorium wire, prepared by Dr de Boer, and I used it as a hot cathode in the X-ray tube of my vacuum spectrograph. With an exposure of 4 hours, with a current of 20 milliamperes under 2·8 kilowatts peak value, I obtained good thorium spectra The middle part of each plate is covered by a filter consisting of goldbeater's foil, $7 \cdot 10^{-6}$ cm. thick, used to estimate penetrating power and order of spectra. All the lines detected are new N and O thorium lines of very low frequency. A very strong 45·3 Å.U. line coincides with the $K\alpha$ line of carbon, but is a different one. This is proved by three facts that tantalum, molybdenum or zirconium hot-wire cathodes, used in the same conditions, do not show the carbon line; that the thorium deposit on the target was very important and visible to the naked eye; that measurements of critical potentials, made with another apparatus, by the ionisation method, do not show at all the carbon K critical potential (287 volts) but the two well-defined N_3 (355 volts) and N_{12} (312 volts) thorium critical voltages, corresponding to the respective emission of 45·3 and 51·5 Å.U. lines.

The strong 45·3 Å.U. line appears in three successive orders and covers, by its broadness, a new line, 48·2 Å.U., which appears only in the second order. This one cannot be the first order line, as it is shown by application of the combination principle, and is, in fact, the highest frequency line in the O series. All the recorded lines fit very closely into the theoretical requirements Only one line, O_5P_3, is missing, probably owing to faintness, its probable intensity being supposed to be only half of that of the 71 Å.U. line.

These lines are tabulated below and designated by the usual terminology:

λ Å.U.	ν/R	Line.	Intensity.	Combination.	Corresponding Energy Levels ν/R.
45·3	21·0	$N\beta$	very strong	N_3 O_{12}	N_3 = 26·2 (directly measured) O_{12} = 5·2
48·2	18·9	$O\delta$	medium	O_6 P_{12}	O_6 = 20·4 P_{12} = 1·5
51·5	17·7	$N\alpha$	strong	N_{12} O_{12}	N_{12} = 23·0 (direct m.), O_{12} = 5·3
71·1	12·8	$O\gamma$	faint	O_4 P_3	O_4 = 14·8 P_3 = 2
121	7·5	$O\beta$	faint	O_3 P_{12}	O_3 = 8·5, P_{12} = 1

The only low-frequency line escaping detection ($O\alpha$) would have a wave-length of about 230 Å.U. It is the last pure Röntgen line waiting to be found. In the short wave-length side of the spectrum, higher frequency N lines are faint and fogged by the strong optical reflection upon the grating of very soft X-rays. Nevertheless two faint lines, 26 and 27·2 Å.U., have once been found.

Remarkable is the simplicity of these spectra in which there is neither spark- nor semi-optical lines, thanks to the small exciting potential. This series of measurements completes in this way our knowledge of Röntgen series and atomic levels and, at the same time, leads to the long-desired spectrographic junction between ordinary X-rays and Millikan optical spectra in the extreme ultra-violet (136 Å.U.: short wave-length limit of aluminium).

A. DAUVILLIER.

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12 Rue Lord-Byron 8ᵉ Arrᵗ., Paris,
September 16.

Prof. Labbé's Production of "Allomorphs."

PROF. LABBÉ in a recent paper (*Arch. Zool. Exp.*, t. 62, p 498, 1924), in speaking of some copepods and other animals, has made the following statement:—

"The eggs of species *A* laid in a medium of *p*H 8·2 would give the form *A*, but at *p*H 8·4 would give the form *A′*, and at *p*H 8·6 the form *A″*. . . .

"It is exact for Artemia, but for the other forms the fact is more important, for it brings about the transition [il conduit à l'émiettement] of one species to another; this is what I shall call the *allomorph* or the allomorphs of the species"

The paper then goes on to state that various allomorphs have been obtained experimentally by a gradual increase in *p*H It also claims that *Cyclops helgolandicus* Rehberg is an allomorph of this type, *Cyclops bicuspidatus* Claus being the real species.

Mr Robert Gurney (NATURE, vol. 118, p. 336, 1926) has severely criticised Prof Labbé's statements and leads one to think that the necessary attention to detail has not been given and that the allomorphs were not really the offspring of the species described. Mr. Gurney suggests that the mistake might have arisen through the accidental introduction of the minute larvæ of other species

I wish to bring forward evidence of an entirely different nature which leads to the same conclusion as that of Mr Gurney.

For the last three years I have been making a detailed study of the genus Cyclops, an important group of copepods, and in every case the *p*H value of the water in which the animals were actually living was taken In this way in Great Britain alone I have recorded 31 species, 5 of which are new to the country and 3 new to science. I do not propose to give here either a full list of the species or of their ranges of *p*H since the work is by no means finished, but I will give simply the ranges observed for a few of the better known ones:

Species.	Range of *p*H.
Cyclops vulgaris	4·6–9·8
„ *strenuus*	4·6–8·6
„ *lucidulus*	4·4–7·4
„ [illegible]	4·6–8·2
„ *pulchellus* (syn. *bicuspidatus*)	5·8–8·6
„ *signatus* (syn. *fuscus*)	5·0–8·0
„ *annulicornis* (syn. *albidus*)	4·4–9·8
„ *serrulatus* (syn. *Leptocyclops agilis*)	4·6–9·8
„ *prasinus*	4·6–9·8
„ *fimbriatus*	5·0–8·1
„ *nanus*	4·4–7·2
„ *venustus*	5·1–7·4

It is more than likely that as time goes on these ranges will be increased, but I have carried out observations in the following districts: The Isle of

Skye, Perthshire, Folkestone and Hythe, Dartmoor, Cambridge, Oxford, and of course Wilts.

When it is found that a number of well-known species such as those given above can be found with such large ranges of *p*H, it seems impossible to accept Prof. Labbé's statement that a small increase of *p*H is responsible for the transition of one species into another.

In this connexion further observations may be cited. I have found *Cyclops fimbriatus* living in three inches of foul muddy water and dredged it up on the same day in 100 feet of clear water from a Scottish loch. Prof Sars records the dredging of exactly the same species from 300 feet of water. This is by no means an isolated case. In addition, many of the species of Cyclops are absolutely cosmopolitan, the same species being recorded from the Arctic Circle to the equator wherever there is fresh water.

As a third kind of direct observation I should add that in a series of experiments on the spine formulae of *Cyclops lacunae*, I bred several generations of the well-known species *C. signatus* and *C. albidus*. The description of these experiments is now in the press and full details are given; suffice it to say here that the animals were bred in jars in an incubator, as controls, and that during the experiments the *p*H gradually went up from 7·2 to 8·6 The spine formulæ were observed as carefully as possible and both species bred absolutely true to type, and I do not know of any more exacting test.

My experiments and observations therefore do not agree with those of Prof. Labbé, and it is surely now almost an established fact that the alterations of *p*H within reasonable limits have little or no direct effect on freshwater entomostraca or insect larvæ, but a profound effect on most of the protozoa It is well known of course that certain animals bred in captivity and under abnormal conditions may give rise gradually to a series of monstrosities, *e.g.* the Chinese gold-fish described by Tornier, but there is nothing in these experiments comparable to the transition of one species into another in Nature

Finally, there is abundant literature, including that given by Prof. Labbé himself, dealing with the continual change of *p*H that takes place normally in any exposed piece of water, and since the entomostracan fauna often remains practically unchanged for weeks and in some cases for months, it is surely obvious that most of the species are not affected by small changes of *p*H, and in some cases they are not affected even by considerable changes

A. G. LOWNDES.

Marlborough.

'Pwdre Ser' (The Rot of the Stars).

PERHAPS I may be allowed to reopen a subject which gave rise to a very interesting correspondence in NATURE in 1910. I refer to the mysterious jelly-like substance found lying about in open spaces, and popularly connected with 'shooting-stars,' about which Prof. T. McKenny Hughes contributed an interesting article to these columns on June 23, 1910. Many suggestions as to the origin of this substance were made both by Prof. Hughes and by later correspondents, but no definite conclusion seems to have been reached. Of course it cannot be taken for granted that the 'jelly' is always of the same nature. It may well be that the 'jellies' recorded by some observers were the plasmodia of Myxomycetes, or masses of Nostoc or some other organism. But it seems to have been suggested so early as 1667 by Merrett that the jelly consisted of the viscera of frogs. He says (I quote from Prof. Hughes) ". . . Regiae Societati palam ostendi solummodo oriri ex intestinis ranarum a corvis in unum locum congestis, quod aliis etiam ejusdem societatis viri praestantissimi postea confirmarunt."

The German observer Melsheimer, again, as was pointed out in these columns by Dr. G. H. Pethybridge, considered the jelly to be the remains of the oviducts of frogs. Melsheimer (*Jahresber. Westfälischen Provinzial-Vereins für Wiss. u. Kunst*, Münster, Sitzung February 28, 1908, p. 53) believed that these were left on the ground, or thrown up undigested, by some animal which devoured frogs, such as the heron, polecat, or water-vole. He also carried out experiments which showed that the oviducts of frogs, if dissected out and exposed to moisture, formed just such masses of jelly, and in some cases eventually became covered with colonies of algæ of the type of Nostoc.

I am in a position to state that the explanation offered by these writers is, at least in some instances, the correct one. My father, the Rev. F. Baylis, who has for some years visited Dartmoor during the summer and autumn, has both last year and this found such jelly-like masses lying on the moor. This year he has forwarded his 'finds' to me for examination, and I have been able to satisfy myself that they consist of parts of the viscera of either frogs or toads. In one specimen the 'jelly' was accompanied by portions of both oviducts in a fair state of preservation, with part of the ovaries, containing the characteristic black eggs, resembling shot, and with the greater part of the animal's alimentary canal, to which the urinary bladder was attached.

What appears to happen is that the gelatinous secretion of the glands lining the oviducts, when exposed to moisture, swells up to such an extent that the oviducts split open longitudinally, and their contents soon assume the appearance of an amorphous jelly. With advancing decomposition, the jelly persists for some time, but the tissue from which it originated may become unrecognisable. I have carefully examined stained microscopic preparations of the tissue, which was on this occasion comparatively fresh, and compared them with similar preparations of the wall of the oviduct of a known frog, supplied by my colleague, Mr H. W. Parker. By this means both Mr. Parker and myself were able to satisfy ourselves completely that the tissues were of the same kind From the fact that the stomach, which evidently belonged to the same animal, contained recognisable remains of a fairly large earthworm, I am inclined to believe that the animal was a toad rather than a frog.

The question now arises: How do the viscera of toads or frogs come to be lying on the ground in such situations? One specimen came from near the top of a 'tor.' If the animal had been swallowed by a heron or other bird, and its remains disgorged, it seems probable that these soft parts would have been digested more rapidly than the muscular and bony portions, of which there is no trace. I am inclined, therefore, to believe that some carnivorous creature (such as the weasel, stoat, badger, crow, or buzzard) is in the habit of disembowelling toads or frogs, and leaving some of the viscera on the site of the 'kill.' It would be interesting to know whether any direct observations have been made which bear upon this question.

H. A. BAYLIS.

British Museum (Natural History),
Cromwell Road, London, S.W.7,
September 21.

Science and Psychical Research.

IN Dr. Tillyard's rejoinder to my letter on this subject, published in NATURE for August 28, he cites Richet as one of the great scientific men who have studied psychical phenomena and have become convinced of their genuineness. He couples Richet with Crookes, Lodge, and others in this respect, but without even suggesting any difference between the individual beliefs of these eminent men. Since I read this my attention has been directed to a statement published by Richet only a little more than two years ago, which appears to me to be of the highest importance

As we know, Crookes believed that the phenomena which he observed were due to spirits—that is to say, to the discarnate manes of deceased human beings—and Lodge too appears clearly to be of the same opinion. From every human point of view this, of course, is a momentous belief, as indicating the survival after death of human personality. But what does Richet believe?—Richet, who is put by Dr. Tillyard in exactly the same category as Crookes and Lodge.

In the *Proceedings of the Society for Psychical Research* for May 1924, in an article on "The Difficulty of Survival from the Scientific Point of View," Richet, after some evident hesitation, makes the uncompromising statement: "I am forced to regard the spiritistic hypothesis, not only as undemonstrated, but, still more, as being in formal opposition to a great number of facts."

Some may perhaps criticise the word 'spiritistic' which Richet uses. It does not appear to be a dictionary word; but it seems clear from the rest of Richet's article that he uses it as meaning 'pertaining to spirits,' and that what he wishes to convey is that he is quite unconvinced that psychical phenomena are in any way due to spirits, or that such phenomena afford any evidence that spirits exist.

It seems to me, therefore, entirely wrong to class Richet as a spiritualist like Crookes and Lodge, as to do so is most misleading.

A. A. CAMPBELL SWINTON.

Amsterdam,
September 28.

As Mr. Campbell Swinton has directed attention to the National Laboratory of Psychical Research in his letter published in NATURE of September 25, I may perhaps be allowed to modify his observations, which I strongly suspect were intended to be disparaging.

The National Laboratory is no more and no less a "purely private concern" than any other society founded for the purpose of scientific investigation and research. The institution is presided over by Lord Sands, and its vice-presidents and correspondents include Viscountess Grey of Fallodon and many eminent psychists and university professors in all parts of the world. The National Laboratory is governed by a council consisting of well-known London medical men and others whose concern is solely to elucidate the deep mysteries of psychic phenomena and, if possible, to discover the laws governing them. A perusal of our list of members would reveal to Mr. Swinton many names famous in various branches of science.

If we have erred in the naming of our organisation, fellow-sinners to the extent of seven columns in the "Telephone Directory" have committed the same 'crime.' Only lack of intelligence or gross carelessness could possibly account for any confusion between the name of our institution and that of the National Physical Laboratory. Both organisations are engaged in an endeavour to increase the sum total of the world's knowledge by scientific means, the only difference being that the National Physical Laboratory is supported by the taxpayers and we are not. I admit that the substitution of the word 'International' for 'National' would more properly describe our activities. Mr. Swinton's remark that the name of our laboratory seems to be *suggestio falsi* is as untrue as it is unjust.

It is curious that 'emotional disturbances' have never before been recorded by means of a thermograph; it is still more curious that at séances with eminent mediums the changes in the sitters' thermal conditions should exactly synchronise with the production of phenomena, witnessed under excellent lighting conditions and simultaneously recorded by means of a dictaphone. The fact is, of course, that when no medium is present the graph shows a steadily rising curve with no lowering of the temperature. But if we have proved that 'emotional disturbances' on the part of the sitters three feet away from the thermograph will lower the temperature several degrees, the founding of the National Laboratory of Psychical Research will not have been in vain!

HARRY PRICE.
(Honorary Director.)

National Laboratory of Psychical Research,
16 Queensberry Place, London, S.W.7,
September 29.

I WOULD not follow Mr. Campbell Swinton further—I have already done so in the correspondence columns of four newspapers—if he did not make a specific attack upon my accuracy. I must vindicate this by explaining the incident mentioned, while admitting that his misreading of it is not unnatural.

I had seen a representative of the *Morning Post* and had suggested that the picture be published. He told me that he feared it would not reproduce. After one interview I thought that I would at least send it up, and I did so, quoting what their representative had said. Therefore I am quite accurate when I say that when I *first* approached the *Morning Post* I made no suggestion that the photograph would not reproduce. How could I, who profess no knowledge of such matters, instruct a newspaper as to whether they could reproduce or not?

ARTHUR CONAN DOYLE.

Windlesham,
Crowborough, Sussex,
September 30.

Distribution of Intensity in the Spectrum of γ-Rays.

NEW information concerning the spectrum of γ-rays may be obtained if we consider the energy of Compton's recoil electrons. As has been shown already (NATURE, 116, p. 206, 1925), these electrons can be observed in a Wilson's cloud expansion chamber. In the case of very fast electrons, their velocity is determined from the curvature of the tracks photographed in a homogeneous magnetic field. The energy of recoil E and the frequency ν of the primary rays are connected by the following relation of Debye and Compton:

$$\frac{E}{h\nu} = \frac{2\alpha}{1 + 2\alpha + (1 + \alpha)^2 \mathrm{tg}^2\theta}, \quad . \quad . \quad (D.\text{-}C.)$$

where $\alpha = h\nu/mc^2$, m is the mass of the electron, and θ is

the angle between the direction of the recoil and that of the primary rays.

Using photographs of the tracks, it is not possible to attain the same accuracy as with the usual methods. But, though only approximate values of the frequency ν can be obtained, this method, nevertheless, provides quite satisfactory results as regards the distribution of energy in the spectrum. Wilson's cloud expansion chamber allows a direct counting of the separate quanta of the scattered radiation, as in this case every observed recoil electron represents one single quantum.

I obtained about two hundred stereoscopical photographs of tracks of secondary electrons, produced in a gas under the action of γ-rays hardened by 3 mm. of lead. Out of all observed tracks, those were chosen where the angle θ lay approximately within the limits of 0°-20°. The value $H\rho$ (H = strength of the magnetic field, ρ = radius of curvature) was determined for 170 tracks, which satisfied the above condition.

The results are shown in the accompanying diagram (Fig 1).

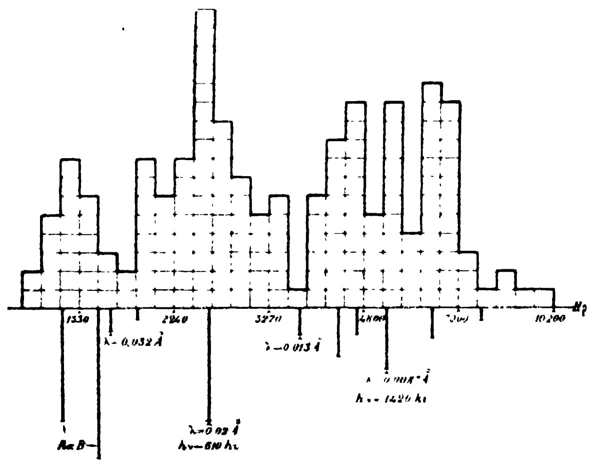


FIG. 1.

The values of $H\rho$ are plotted on a logarithmic scale, one division of which corresponds to about 8 per cent. of the value $H\rho$

The number of squares corresponding to one division is equal to the number of observed electrons for which the value $H\rho$ was found to lie in the limits of the given division. Definite values of $H\rho$ are also given for each separate line of the spectrum of γ-rays, found by Ellis (*Proc Cam Phil Soc.*, **22**, 369, 1924); these values of $H\rho$ correspond to those for the energy E, which follow from relation (*D.-C.*) in the case of ν being put equal to the frequency of the given line and the angle θ to 10°. On the diagram the separate lines of Ellis's spectrum are represented by straight lines, the lengths of which are proportional to the intensity of the corresponding line, as given by Ellis

The distribution thus obtained corresponds, in its outlines, to Ellis's spectrum, as could be predicted from the quantum relation (*D.-C.*)

It is probable that, in the interval $0{\cdot}03 > \lambda > 0{\cdot}014$ A.U., there exists either a continuous γ-radiation or some more lines beside those registered by Ellis (This assumption is in accord with Thibaud's research (*Ann. de Phys.*, vol 5, 73, 1926).)

In order to determine the intensities in the primary beam, we have still to account for the probability of recoil in the given conditions (θ 20°). Compton's theory gives a definite value for this probability. The distribution of intensities which can be deduced directly from my experimental data did not agree with the distribution obtained by Ahmad, who has used the ionisation method and also based himself on Compton's theory (*Proc. Roy. Soc.*, **109**, 206, 1925).

D. SKOBELTZYN.

The Physical-Technical and
Polytechnical Institutes,
Leningrad, August 22.

Light-Organs in Littoral Cephalopoda.

THE large group of pelagic 'squids' known as the Egopsida, which includes the greatest number of families of living cephalopods, is characterised by the frequent occurrence of light-organs situated in a variety of places both on the outer surface and within the mantle-cavity. The Myopsida (which include the true squids (Loligo) and cuttlefish (Sepia)), on the other hand, are poor in luminous species. Dr. S. S. Berry in his recent survey of the occurrence of luminous organs in Cephalopoda (*Biological Bulletin*, **38**, 1920, pp. 141 and 171) lists 99 luminescent species of Egopsida (57 per cent), 27 of Myopsida (12 per cent) and 2 of Octopoda (1 per cent). We cannot believe that these organs are necessarily correlated with the habit of living permanently in, or periodically descending to, great depths. Many of the Octopoda are permanent inhabitants of the deeper layers of the sea and are yet devoid of luminous organs. There may be some special source of correlation between the occurrence of light-organs and abyssal habitat which may be responsible for the occurrence of the former among the Egopsida, but not among the Octopoda Of this we have no certain evidence at present

The view that the presence of light-organs is directly correlated with reduction of light, and hence with abyssal habitat, gains some support from the fact that, while many Egopsida have a considerable vertical range, in the Myopsida, which are regarded as mainly littoral in habit, light-organs occur in only 12 per cent. of the species The exact vertical range of individual genera of Myopsida is a little obscure, and it is obvious that in several of them it is considerable Due consideration must of course be given to the fact that unless a specimen is taken in a closing net the exact depth of its regular habitat cannot be satisfactorily assessed However, there is not much doubt that the Sepiolidae inhabit relatively shallow water (down to about 100 fathoms), while the Loliginidae and Sepiidae are definitely littoral, though it is at present uncertain how deep they range in the course of their reproductive cycle. Nevertheless, paired photogenic organs situated immediately over the ink-sac were recorded by W Meyer (*Zool. Anz.*, **30**, p. 388, 1906) in *Sepiola rondeletii* (surface - 100 fathoms) In the Loliginidae and Sepiidae, two very large families, no photogenic organs at all were recorded by Berry in his survey of the group (see above). Thanks, however, to the acuteness of M Armand Krempf, director of the oceanographical and fishery service of Indo-China, and to the courtesy of Dr. R. Ph. Dollfus, Secrétaire Général de l'Institut Scientifique Chérifien, I am able to record the occurrence of rectal light-organs, exactly similar to those of *Sepiola rondeletii*, in a new species of Loligo (shortly to be described) from Indo-China The species in question is obviously of littoral habit.

The general considerations outlined above and this new observation render it very desirable to collect exact data as to the distribution and habits of these animals. Without such data it must remain impossible to decide whether these luminous organs are adaptive

in the usual sense of that word and, if so, to what needs they correspond (*e.g.* the search for food or the attraction of mating-partners), or whether they are at the offset developed without reference to the welfare of the organism. G. C. ROBSON.

British Museum (Natural History),
South Kensington, London, S.W.7,
September 22

Electrostatic Moments of Molecules.

I HAVE made recently some observations on the electrostatic moments of molecules. A beam of molecules, all having sensibly parallel velocities, was passed through an electrostatic field, so arranged that the quantity d^2v/dx^2 (x measured perpendicular to the direction of the molecular motion) was of the order of 10^6 e.s.u./cm ^{2}. Experiments were made on the metal potassium and on the compounds sodium chloride, mercuric chloride, and arsenic trioxide. It was found that potassium had a moment too small to detect, and it has been impossible so far to induce any polarisation in the molecule in the largest field used—330 e.s.u./cm. There was no deflexion which might be put down to the molecules $(K)n$. If such are present their concentration must be very small—less than 1 per cent. of the total number, or they have no moment and the field cannot polarise an appreciable number of them.

Some experiments of a qualitative sort have been done on the binary and ternary compounds sodium chloride and mercuric chloride. The molecules of both these substances were deflected appreciably by the field, and the moment was estimated to be of the order of magnitude 10^{-18} e.s.u. cm. As these experiments were done with the aid of a knife edge, it is difficult to estimate the field through which the molecules passed.

With a much better apparatus in which a charged wire was placed in the path of the moving molecules, an experiment was done on arsenic trioxide. In this case several deflected lines were visible, and the moment deduced appears to be somewhat larger than in the case of the other two salts. It is difficult without a systematic series of experiments to offer a definite interpretation of these observations, as there is to be taken into consideration a number of possible effects, for example, the rotational energy of the molecules, the polarisation which the field may induce in them, and finally, effects due to different molecular states. R. J. CLARK.

The Cavendish Laboratory,
Cambridge.

Lengthened Chain Compounds of Sulphur.

IN a recent issue of NATURE (August 21, p. 283) attention is directed to some lengthened chain compounds of sulphur described by Sir P. C. Rây and K. C. Bose-Rây (*J. Indian Chem. Soc.*, 1926, 3, 75) as products of the interaction of dithioethylene glycol and ethylene dibromide. Of the three points which are emphasised by the authors, namely, (*a*) the isolation of a compound containing bromine, (*b*) the high molecular weight of this compound, and (*c*) its formulation as having a long chain structure, two cannot be regarded as new, whilst the evidence for the third is unconvincing. For the very similar reaction of ethylene dibromide with potassium sulphide was shown by Crafts so long ago as 1863 (*Annalen*, **128**, 220) to yield such substances of presumably high molecular weight containing 12-28 per cent. of bromine and with a ratio of C : H = 1 : 2. Moreover, the suggestion that these substances have a long open chain structure has recently been put forward on more than one occasion (*J. Chem. Soc.*, 1921, **119**, 1861 ; 1925, **127**, 2676).

It seems probable that such products are mixtures of substances of the general formula $A.(S.C_2H_4)_n.S.B$, where A and B may be alike or different and have any of the structures: $-CH_2.CH_2OH$, $-CH:CH_2$, or $-CH_2.CH_2X$ (where X is a halogen). If n be large, the composition of the whole will differ very slightly from that of a polymer of ethylene sulphide. But at the same time the easy isolation of a single pure chemical individual from such a mixture of closely related substances is not to be expected.

The experiments recorded by Sir P. C. Rây do not in fact provide any convincing evidence that such a separation of pure substances was effected, although it is claimed that this was so after one or two crystallisations. There are also several indications in the paper that the "compounds" were still mixtures. For example, it is improbable that members of what would constitute a single homologous series of compounds of the general formula $Br.C_2H_4(S.C_2H_4)_n.Br$ would have the following melting points when pure:

Value of n .	10	12	16	24	26	32	40	48
Melting point .	120°	100°	162°	117°	145-155°	157-159°	170°	163°

In no case was the molecular weight of one of these substances satisfactorily confirmed. The ebullioscopic determination made on one of them led to a value about half of that expected (1486 in place of 3068). The authors attribute this to a surprising disruption of the molecule by the ethylene dibromide used as a solvent, but it is much more likely to be due to the presence from the first of a mixture of substances some of which do not contain bromine. In any case it cannot reasonably be claimed that any substance was shown to have the high molecular weight stated. G. M. BENNETT.

The University,
Sheffield.

Prof. Paul Kammerer.

I REGRET to have to announce the death of Prof. Dr. Paul Kammerer, who shot himself on the Hochschneeberg, near Vienna, on September 23. In a letter (received after his death) he accuses himself of failures in his personal affairs, but emphasises that he has never committed the scientific tricks hinted at by some of his critics. He deemed the rest of his life too short to be able to take up again the same experiments, and declared himself too weary for this task. Although other than these seem to have been the main causes for his weariness of life, yet this sad end to a precious life may be a warning to those who have impugned the honour of a fellow-worker on unproven grounds. It is in fulfilment of a wish expressed by Kammerer that I beg the editor of NATURE to publish his last word on the much-debated but not solved question of a particular one of his specimens. Having convinced himself of the state it is in now, Kammerer alleges that someone must have manipulated it ; he does not allude to a suspicion whom this might have been.

Need I add that Kammerer's work on the modifiability of animals, especially on poecilogony and adaptation to colour of background in Salamandra and the reappearance of functional eyes in Proteus kept in appropriate light, will secure him a lasting place in the memory of biologists, even if some other of his papers were open to criticism.

HANS PRZIBRAM.

Vienna II. Prater, "Vivarium."

English Provincial Universities: Demand and Supply.

THE elevation of University College, Reading, to full university status has naturally led to a certain amount of speculation as to the prospects of other colleges which aim at achieving a like development. A careful survey of the demand for and supply of university education in Great Britain was included in last year's Report of the University Grants Committee, which pointed out that in spite of serious financial distress among the classes from which university students are mainly drawn, in spite of a rise in fees and in personal expenses, there were 56·9 per cent. more full-time students of both sexes at British universities and colleges than before the War. There can, the committee thought, be little doubt that the demand for university education cannot long remain stationary even at this higher level, and that it will continue to grow both in volume and intensity. The growth is, in fact, clearly traceable to causes which are likely to operate in the future with increasing force.

One may distinguish between the demand for professional or vocational education at a university—the bread-and-butter studies—and the demand for the other advantages which a university education offers, advantages associated with the ideal of a 'liberal education.' Both have been and are being stimulated by the rapid increase in the secondary school population, which has multiplied the number of young people fitted for and capable of appreciating the value of university training while creating a demand for more teachers which the universities alone can properly supply. The ever-extending applications of science to industrial purposes, the instalment by industrial concerns of private laboratories and research departments, and the development of industrial research associations, provide an ever-widening field for men and women trained in the scientific departments of universities. There is, moreover, in the world of commerce and industry a growing appreciation of the value of the university-trained mind, and the opinion gains ground "that for the direction of operations which tend every day to become more and more dependent for their success upon the understanding of a complicated network of world conditions, disciplined imagination, breadth of outlook, and mastery of general principles are the qualities needed—qualities which it is the object of a good university education to develop." Meanwhile the demand of the learned professions and the public services grows no less, and the local government authorities have begun to compete with the central government for the services of university graduates.

Partly as a result of the widening of the university area of influence, there has come about a broadening of the basis of university studies in all faculties, and this has tended to increase the number of those who would pursue at a university the ideal of a 'liberal education.'

A potent cause of growth in the *effective* demand for university education in Britain has been the generous provision by local authorities of scholarships tenable in universities. It has been estimated that this amounts to something like 300,000*l*. per annum.

So much for the demand. In discussing the question whether the supply would be able to meet it, the committee directed attention to its statistics of students in attendance at each of the universities, and pointed out that there are few at which there is not ample scope for expansion without any danger of introducing the methods of mass production—expansion which would meet all the needs likely to arise for a good many years to come, at much less cost than would be incurred in creating new universities or raising to the university level institutions which are now below it: "We consider that a relatively small number of universities, staffed and equipped on a worthy scale, will be of more value to the nation than a larger number of universities of inferior strength."

Turning now from these general considerations to particular examples, the present position and prospects of the three university colleges at Nottingham, Southampton, and Exeter may be briefly described as follows:

UNIVERSITY COLLEGE, NOTTINGHAM

This College was founded by the municipality of Nottingham and opened in 1881 by the Duke of Albany; it took up the Cambridge extension courses, of which Nottingham was one of the earliest centres, and the evening classes which for many years had been held at the Mechanics' Institution. From these beginnings it has developed its present work.

The College building, which houses also the Free Public Library, is situated in the centre of the city, but new buildings are in process of erection on a very fine site, three miles distant, presented by Sir Jesse Boot as part of a gift of 350,000*l*. made in 1920 to the city of Nottingham. From the gift, 110,000*l*. was allocated to the new buildings, for which Sir Jesse Boot made supplementary gifts amounting to 40,000*l*. An anonymous donor gave 100,000*l*. in 1922 as a contribution towards the establishment of an "East Midlands University," and this sum was added to the building fund, making 250,000*l*. in all. Sir Jesse Boot has since added to his benefactions; among other gifts he has provided 12,000*l*. more for the buildings and 9000*l*. for the sports ground. The present buildings in Shakespeare Street will continue to house the technical day courses and the evening classes.

At the ceremony of laying the foundation-stone of the new building on June 14, 1922, Lord Haldane suggested that a university for the East Midlands might be organised on something like the pattern which is now in operation in Wales, the university looking to the constituent colleges to develop the teaching of their own students and preserve all the records and to conduct examinations for degrees under the university's supervision. He thought it would be possible to start a university on these lines with four faculties: arts, science, engineering, and commerce. The other constituent colleges of the projected university were not named, but Leicester, Loughborough, and Derby are all within easy reach, and the colleges at those places would presumably come into the scheme.

The instruction at University College, Nottingham, is organised in faculties of arts (including education and music), economics (including commerce and law), pure science (including pharmacy), and applied science (engineering and technology, textiles and mining). A department of adult education is conducted by a whole-time professor, assisted by four staff tutors, two organising lecturers, and about thirty-five part-time tutors and lecturers. The College has shown

great enterprise in developing this department to a high degree of efficiency since the War. It makes special provision for the instruction of foreign students throughout the academic year.

Much advanced work is carried on, there having been in 1924–25 twenty-four research students in addition to students doing post-graduation work in education or in secondary training. The total number of full-time students in 1924–25 was 472, including 175 women. The distribution by faculties was: arts and economics, 204 (women 130); pure science, 204 (women 45); medicine, 6; technology, 58. Ninety-seven students were accommodated in residential halls. Part-time students numbered 734 (women 97), and there were in addition 1545 students taking courses not of a university standard, and 1867 university tutorial class three-year students.

On the score of amount of instruction provided and research work undertaken, Nottingham ranks higher than Reading. It is in provision of residential halls for its students and in finance that it falls short. A scheme for providing additional halls of residence both for men and for women has, however, been begun and has already received contributions and promises of support. The total income of the College in 1924–1925 was 59,609*l*. as against Reading's 84,150*l*., and its income from endowments 1600*l*. as against 12,148*l*. Its grants from local authorities amounted to 14,532*l*. plus 2500*l* set apart for scholarships, hostels, etc.; its parliamentary grants to 25,548*l*., its tuition and examination fees to 12,878*l*., and other income to 5051*l*.

The book value of its lands and buildings and permanent equipment is 405,888*l*., and its endowment investments 2381*l*. A few more bequests such as that of Mr. W. H. Revis (37,000*l*.) would enable the College, either alone or in association with others, to make out a very strong case for a university charter.

UNIVERSITY COLLEGE, SOUTHAMPTON

The College at Southampton originated in the Hartley Institute for Technical Training, founded in 1850 and formally opened by Lord Palmerston in 1862. For thirty years its function was that of a technical college only, but in 1899 it was recognised by the Board of Education as a training college for teachers. Three years later (after investigation and report by the Treasury) the College was promoted to a place in the list of university colleges in receipt of Treasury grant. New buildings on the outskirts of the town were opened on June 20, 1914, by Lord Haldane. On the outbreak, six weeks later, of the War, the College authorities handed over the buildings to be used as a hospital, and it was not until October 1919 that the College actually took possession of its new home. The buildings are not yet completed, and a good deal of the work now being done is carried on with huts as lecture rooms and laboratories.

The College prepares students for degree examinations of the University of London, the examinations of various professional bodies such as the Pharmaceutical Society, Institute of Chemistry, Institutions of Mechanical, Civil and Electrical Engineers, Royal Institute of British Architects, Surveyors' Institution, Law Society, etc., and for its own diplomas in engineering, commerce and economics, geography, law, music, and English (for foreign students). Its department of education for the training of teachers has a high standard of admission (London matriculation) and prepares students not only for the Board of Education's Certificate examination (conducted internally, at the College) but also for the teachers' diploma and higher diploma in pedagogy of the University of London and other advanced examinations in professional subjects. An increasing number of these students take also university degree examinations. The original work of the College as a technical institution still flourishes in the shape of evening classes in arts, pure and applied science, engineering, etc. There is an old students' association with nearly two thousand members.

In 1925–26 the number of full-time students was 316, including 157 women. The number resident in college hostels was 192 (women 94). Two-thirds of the full-time students (82 men and 131 women) were working in the Faculty of Arts; 86 were students of pure science; 17 were engineering students. Part-time students numbered 294, including 28 women. In addition, there were 253 students taking courses not of a university standard and 112 students attending university tutorial (three-year) classes. The book value of lands and buildings as at July 31, 1925, was 64,591*l*., and endowment investments amounted to 12,347*l*. The total income of the year 1924–25 was 31,962*l*., derived from: parliamentary grants (15,139*l*., increased in 1925–26 by 4000*l*.), local authorities' grants (9236*l*.), tuition and examination fees (6094*l*.), endowments (644*l*.), and other sources (849*l*.). Student expenses have been kept low, and it is claimed that a university education may be acquired at Southampton at an inclusive cost of 105*l* a year.

Although the College is able at present to pay its way, further expansion and improvement are dependent on the success of efforts now being made to raise additional funds. In May 1925 an appeal was launched for 500,000*l*. for the endowment of chairs and the provision of additional buildings, with the view of eventually obtaining a charter for a projected "University of Wessex." Geographically, Southampton would seem to be the most appropriate centre for university education for East Dorset, South Hants, the Isle of Wight and Channel Islands, and West Sussex. The towns of Poole, Bournemouth, Salisbury, Portsmouth, Winchester, and Chichester are all within easy distance. In 1925–26, 119 out of the total number (316) of full-time students lived at home, and 72 others came from homes within a radius of thirty miles, whilst 125 came from beyond that radius.

The case for a University of Wessex rests partly on the regional demand, present and prospective, for regional facilities for university education, and partly on the incidental and indirect benefits likely to accrue to the inhabitants of the region in consequence of having a university in their midst. It may be anticipated, therefore, that Southampton will, like Nottingham, largely develop its university extension activities and its commercial and technological departments. Southampton being within such easy reach of French ports, a university with a strong faculty of commerce would attract many students from France. The engineering department of the College is at present a small one, but its efficiency is proved by the fact that the students when they leave college readily obtain employment, and some of them have already risen to very considerable distinction. Were money forthcoming, this department would be capable of important developments, especially in the study of marine and aeronautical engineering, for which Southampton offers excellent opportunities.

UNIVERSITY COLLEGE, EXETER.

The University College of the south-west of England, Exeter, formerly known as the Royal Albert Memorial College, originated in 1865, when memorial buildings consisting of a museum, a library, and adjuncts for the study of art, science, and literature were erected. With the co-operation of the Local Lectures Syndicate of the University of Cambridge, the work of the

institution was re-modelled and co-ordinated in 1893, when the first principal was appointed, but it was not until 1901 that the educational work was organised for development on the lines of a university college with the provision of a curriculum for the external examinations of the University of London.

The College was placed upon the list of university institutions in receipt of grant from H.M. Treasury as from August 1, 1922, when it was incorporated under its present name as a company limited by guarantee, and the college buildings and halls of residence were transferred to it by the Exeter City Council. From that time its progress has been rapid, the number of degree students in the four years ending 1924–25 having been 96, 139, 187, and 211 respectively. The total number of full-time students in 1924–25 was 332, of whom 221 were in the teachers' training department. Residential halls provide accommodation for 134 women and 110 men students. Part-time students numbered 38 and occasional students 40. There are departments of biology, chemistry, classics, education, English, geography, history and economics, law, pure and applied mathematics, modern languages, music, philosophy, physics, and extra-mural studies. The total income was 29,067*l.*, including parliamentary grants 12,317*l.*, grants from local education authorities 10,384*l.*, tuition and examination fees 5040*l.*, income from endowment 674*l.*, and from other sources 1112*l.* The book value of its land, buildings, and permanent equipment is 81,433*l.*, and its endowment investments 11,603*l.*

These figures do not suggest that the College is likely to qualify soon for full university status, but it might conceivably join with the Technical Schools, Plymouth, the Seale-Hayne Agricultural College, Newton Abbot, and the Camborne School of Mines, to form a federal university. An important scheme for co-operation with the Technical Schools, Plymouth, has been worked out providing for degree and diploma courses in civil, electrical, marine, and mechanical engineering and in commerce at Plymouth, and the extension of the law teaching and extra-mural work already carried on there by the College. An appeal was launched in October 1925 for 100,000*l.* for the equipment and endowment.

University College, Hull.

The plans for the proposed University College for Hull, for which the Right Hon. T. R. Ferens gave 250,000*l.*, provide for an organisation somewhat similar in scope to that of University College, Southampton, with the addition of a department of agriculture and, eventually, departments of shipbuilding and applied chemistry of the oil, colour, gas, and spirit industries.

Lest the account already given of the policy of the University Grants Committee in regard to proposals for establishing new universities should be misunderstood, it must be added that the Committee is careful to point out that its "view of what is prudent at one particular stage of our history betokens no lack of sympathy with the general desire for a wider avenue to university education, or with the ambitions of certain large and populous cities to rival the more fortunate communities which already possess universities of their own." The Committee hopes that "as returning prosperity enables the schemes of local education authorities under the Education Act to be carried into effect, the local colleges will play an increasingly distinguished part in the higher education of the people, and will steadily raise the level of national knowledge and culture. It may well be that some of these will, in course of time, establish a claim to university rank and receive charters as independent universities."

Fluctuations in the Abundance of a Species considered Mathematically.

By Prof. Vito Volterra, For. Mem. R.S., President of the R. Accademia dei Lincei.

A consideration of biological associations, or of the mutual interactions between two or more species associated together, has led me to certain mathematical results which may be set forth as follows.

The first case I have considered is that of two associated species, of which one, finding sufficient food in its environment, would multiply indefinitely when left to itself, while the other would perish for lack of nourishment if left alone; but the second feeds upon the first, and so the two species can co-exist together.

The proportional rate of increase of the eaten species diminishes as the number of individuals of the eating species increases, while the augmentation of the eating species increases with the increase of the number of individuals of the eaten species. Having determined the laws of this increase and diminution, it is possible to establish two differential equations of the first order, non-linear, which can be integrated. The integrals reveal the fact that the numbers of individuals of the two species are periodic functions of the time, with equal periods but with different phases, so that each species goes through a cycle relative to the other during a period, a process which may be called the 'fluctuation of the two species.' Figs. 1 and 2 give representations of different possible cycles, corresponding to different initial values of the number of individuals of the two species: ordinates representing the eating, and abscissæ the eaten species.

The co-ordinates of a point on a cycle are the concurrent values of the numbers of individuals of the two species, those of the central point Ω being the mean values; and the following laws have been deduced from integration of the differential equations which represent the fluctuation:

I. The fluctuation of the two species is periodic, the period depending only on the coefficients of increase and of destruction of the two species, and on the initial numbers of the individuals of the two species.

II. The average numbers of the two species tend to constant values, whatever the initial numbers may have been, so long as the coefficients of increase or of destruction of the two species and also the coefficients of protection and attack remain constant. (Laws I. and II. are illustrated in Fig. 2.)

III. If we try to destroy individuals of both species uniformly and proportionately to their number, the average number of individuals of the *eaten* species grows and the average number of the eating species diminishes (see Fig. 1). But increased protection of

[1] V. Volterra.—Variazioni e fluttuazioni del numero di individui in specie animali conviventi.—*Memorie della R. Accademia dei Lincei* (Cl. di Sci. Fis. etc.), ser. 6, vol. ii. fasc. 3, 85 pp., 1926.

the eaten species increases the average numbers of both.

In the case of small fluctuations, we have the following approximate laws:

(1) Small fluctuations are isochronous, *i.e.* their period is not sensibly affected either by the initial

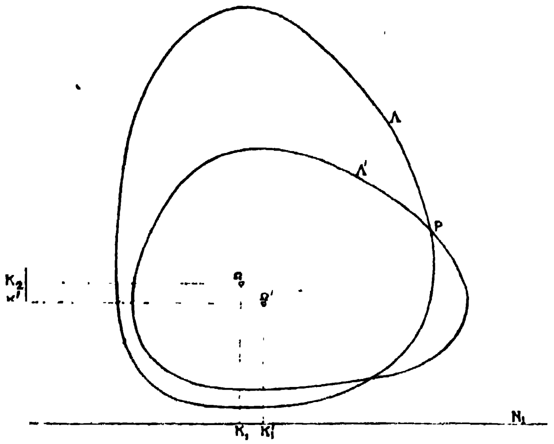


FIG. 1.

number of individuals, or by the conditions of protection and offence.

(2) The period of fluctuation is proportional to the product of the square roots of the time required for the first species to double itself, and for the second species to reduce itself to half. If the first species doubles itself in the time t_1 and the second species is reduced to half in the time t_2, the period is $T = \frac{2\pi}{\log_e 2}\sqrt{t_1 t_2} = 9{\cdot}06\sqrt{t_1 t_2}$.

(3) The steady destruction of individuals of the eating species accelerates the fluctuation, and the destruction of individuals of the eaten species retards it.

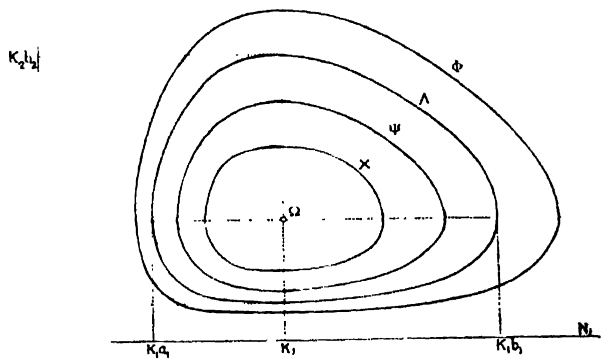
With the contemporaneous and uniform destruction of individuals of the two species, the ratio between the amplitude of the fluctuation of the eaten species and that of the eating species tends to increase.

In Fig. 1 are represented two cycles, the second of which corresponds to a perturbation produced in the first by a constant and proportionate destruction of the individuals of the two species. The centre Ω' of the perturbed curve is displaced, in respect to the centre Ω of the primitive curve, downwards and to the right; this reveals an augmentation of the average number of individuals of the first species, and a diminution of the average number of the second.

Law III. is undoubtedly the most interesting of all, because it affords the best actual verification so far found of the theory. For Dr. U. d'Ancona, comparing fishery statistics in the Adriatic Sea before the War, during the War (when fishing almost ceased), and after fishing was resumed at the end of the War, has ascertained that the voracious species (selachians), which feed on other fishes, had increased during the War as compared with the preceding and following periods, while the contrary had been the case for the number of individuals of the eaten species.[2] In other words, a complete closure of the fishery was a form of 'protection' under which the voracious fishes were much the better and prospered accordingly, but the ordinary food-fishes, on which these are accustomed to prey, were worse off than before. This is in agreement with Fig. 1, and with Law III. My theoretical researches, which I was induced to undertake by the statistical studies begun by Dr. d'Ancona, correspond accordingly with his results.

Charles Darwin had an intuition of these phenomena in relation to the struggle for existence when in Chap. iii. of his "Origin of Species" he wrote: "The amount of food for each species of course gives the extreme limit to which each can increase; but very frequently it is not the obtaining food, but the serving as prey to other animals, which determines the average number of a species. Thus there seems to be little doubt that the stock of partridges, grouse, and hares on any very large estate depends chiefly on the destruction of vermin. If not one head of game were shot during the next twenty years in England, and at the same time if no vermin were destroyed, there would in all probability be less game than at present, although hundreds of thousands of game animals are now annually shot."

Law III. is, however, true only up to a certain limit. It is evident that if the destruction of both species continue, their exhaustion will ensue. It is therefore necessary to ascertain up to just what point it is profitable to destroy both species in order to obtain the greatest augmentation in the average number of the eaten species. We arrive in this manner at a curious example of a mathematical *upper limit* without the existence of a *maximum*. There is in fact a limit of destruction beyond which both species are exhausted. If we remain below it, the average number of the eaten species grows as this limit is approached; but once the limit is reached, the eating species tends to exhaustion and the fluctuation ceases, while the number of individuals of the eaten species tends asymptotically



towards a value which is less than the average formerly reached.

Besides the case dealt with above, a study of variations in the number of individuals of two associated species can also be made in all cases in which the species interact either favourably or injuriously, in all possible degrees or combinations. All such cases can be classified in distinct types, and in each of these it is possible to

[2] U. d'Ancona.—Dell' influenza della stasi peschereccia del periodo 1914-1918 sul patrimonio ittico dell' Alto Adriatico.—*Memorie del R. Comitato Talassografico Italiano* (in course of publication).

follow the numerical variations of the two species by the help of formulæ, or of diagrams to correspond. It is easy to see from these diagrams *which species is winning in the struggle for existence, and which of them is in process of extinction.*

Again, it is certain that many facts of medical interest may be classed among phenomena resulting from concurrent and reciprocal action between different species—between the human species and pathogenic germs, between parasitic species and those on which they are parasites. The periodicity of epidemics may be connected with the same phenomena.

A second part of my investigation is devoted to a general study of biological association, where any number of species may be living together. I have studied two types of association, and have called them *conservative* and *dissipative associations.*

For the first or conservative association, equivalent values may be assigned to the different species so that the destruction of a certain number of individuals belonging to one species by another species, to its own benefit, corresponds to an increase in numbers of the latter species, in the precise ratio which the said equivalents express. Moreover, in a conservative association, the number of individuals of every species has no influence on its own augmentation. The case of two species, already dealt with: the case of n species, where individuals of the first eat those of the second, and the latter those of the third, and so on to the nth; the case of four species so connected that the first eats the second and the second is also eaten by the third, which in its turn is eaten by the fourth; all these cases are examples of biological conservative associations, if we neglect actions between individuals of the same species. The variation in numbers of the conservative associations depends on a system of differential quadratic equations associated with a skew-symmetric determinant.

Owing to the peculiar properties of these skew-symmetric determinants, and to the differences between those of odd and those of even order, we must treat in different ways the cases where odd and where even numbers of biological species are associated together. When the number is odd, then, if the coefficients allow a 'stationary state,' we shall always have fluctuations such as to maintain the number of individuals of each species between positive limits. These limits are dependent on initial conditions, which may be so assumed as to restrict these limits to any extent we please.

The average numerical values of the different species tend, in periods of time of infinite duration, towards the corresponding values for the stationary state, and are therefore independent of the initial values.

The case of an odd number of species does not correspond to a condition of stability for a strictly conservative system.

In the case of associations which I call *dissipative*, if a stationary state exists, the variations will be fluctuations which slowly extinguish themselves, or are asymptotical. From an analytical point of view, the dissipative association is characterised by a definite positive quadratic form.

The analogous form is null in the case of a conservative system. The dissipative actions work in a way analogous to friction in a mechanical system.

Therefore the terms conservative and dissipative may also be applied to the fluctuations, which in the first case continue to exist, and in the second are dissipated. It will be observed that to prove the existence of the fluctuations, we follow an analysis different from that used in elastic or electric vibrations, the equations here employed being not linear but quadratic.

Applying this theory to a particular case, suppose three different species living together in a limited area, such as an island. Of these three species the first eats the second, which in turn eats the third. We may take for example a carnivorous species, feeding upon a herbivorous animal, which in turn feeds on a certain plant species—assuming that for the last the same method may be used which we apply to animals. The same method may also be employed in the case of insects parasitic upon plants, and of parasites of such parasites.

If we suppose that system to be conservative, that is, if we neglect the actions between individuals of the same species, we may have two different cases which are distinguished by the values of the coefficients occurring in the equations:

(1) The food which reaches the carnivorous species through the herbivorous is not sufficient to maintain the carnivorous species; and so the latter is exhausted, while the herbivorous animal and the plant tend to a periodical fluctuation.

(2) The vegetable species grows indefinitely. This case is, however, incompatible with the limitation of the island, which does not allow the indefinite multiplication of the plant. It is therefore necessary in this case to suppose the system to be dissipative, admitting that the coefficient of increase of the vegetable species is dependent on the number of existing plants, and then we have three cases: Either (1) both animal species are exhausted; or (2) only the carnivorous species is exhausted, while the herbivorous and the plant tend to a fluctuation of gradually diminishing amplitude or to an asymptotic variation; or (3) all three species live together without exhausting themselves, but vary asymptotically in a common fluctuation of gradually diminishing amplitude, the characteristic elements of which can be determined.

Side by side with the general theory, we may make various special inquiries. Thus, for example, we may suppose the coefficient of increase of the species to have an annual period, a supposition tending to establish a law of forced fluctuations superposed on the free fluctuations of the biological association considered.

We may also study how exhaustion takes place of a species in a biological conservative association of an uneven number of species; or in general how exhaustion takes place of species in dissipative associations; or what perturbation is produced when a new species is introduced into an association in equilibrium.

Seeing that a great number of biological phenomena are characteristic of *associations* of species, it is to be hoped that this theory may receive further verification and may be of some use to biologists.

Obituary.

ARTHUR WALTON ROWE.

HARD as it is to see friends go who have played their part upon our shifting stage, it is still harder to lose those who are in the plenitude of their power, before they have fully delivered the message you know they have in them. Arthur Rowe was one of the most remarkable, complex and cryptic natures it has been my fortune to encounter. During the past five and twenty years, probably no one has been on closer terms of continued intimacy with him than I was. We came together in a curious way. At the close of 1900, I had a bad attack of influenza. Feeling very miserable and having little faith in local medical opinion, I said I should go to Margate and put myself into the hands of a physician there who, I knew, had done remarkable geological work: therefore, should be of exceptional intelligence. I did so and fortunately called in Rowe—only to discover that I had pneumonia upon me. Happily we soon disposed of this and then began to talk shop together. I had advisedly taken with me a bookful of my photographs displaying the geology of the Dorset coast. He had just published the first of his papers on "The Zones of the White Chalk of the English Coast—Kent and Sussex," unillustrated. He proposed that we should join forces. So it came that I illustrated for him Parts II. to V. (Dorset 1901, Devon 1903, Yorkshire 1904, the Isle of Wight 1908), which were published by the Geologists' Association.

Rowe was born September 27, 1858. He died September 17, 1926. He was the son of Dr. Thomas Smith Rowe of Margate. He led a very lonely childhood and started geology when quite a boy—in fact, he was a naturalist from birth. His parents were very strict with him, stinted his pocket money and allowed him no youthful companions. He was educated at King's School, Canterbury, at the University of Durham and St. Mary's Hospital.

Rowe began to practise with his father in 1884 and held the house surgeonship at the Royal Sea Bathing Hospital at about that time. He retired in 1910, after having long been the leading practitioner in Margate. He was adored by his patients. He worked very hard at his practice and was able to develop his bent as a scientific inquirer only on Sundays and holidays—a fortnight at Easter and a fortnight in the autumn.

Rowe was a very difficult character to understand. Naturally reticent, his reticence was accentuated by the overmastering tendency of medical etiquette to compel reticence and he became more and more asocial with time. He was given to hobbies and an unusual mixture of the naturalist-collector with the highest type of scientific inquirer—I use the term inquirer advisedly. Excepting Lapworth, no one has so impressed me in the field. He had an exceptional faculty of learning and mastering a subject, an exceptional sense of order and exactness, an exceptional care for truth. His devotion to work was extraordinary. The phrase used by W. P. D. S. in the *Times*—"Whatever he took up (and he took up many things) he did more thoroughly than any other man I have known"—is an exact description of him. Whatever subject he took up, for the time being he thought of nothing else and could talk of nothing else. Unfortunately, he had in him no element of personal ambition—years ago, when some of us wished to prefer his claim to the Royal Society, he would allow nothing of the kind. As the Society has no means of discovering modest men, he remained unencouraged—except by the Geological Society, which gave him the Wollaston award in 1901 and a Lyell medal in 1911. Quite exceptionally, two Lyell medals were awarded that year, the other recipient being Dr. Bather. There was a tie in the voting between amateur and professional.

We owe the earliest attempts at zoning the Upper Cretaceous to Price and Barrois. Little was done, especially with the Upper Chalk, until Rowe took it in hand. He had developed a beautiful method of uncovering and displaying the exterior characters and internal structure of fossils, especially the more delicate forms preserved in the Chalk (involving the use of the dental engine). This enabled him to reveal minute variations in shape and aspect previously unsuspected. Collecting the material personally, he noticed that these variations were in sensitive relation with the exact position of the organisms in the succession of the Chalk strata and it occurred to him that the fossil sea urchins in particular might be useful as indicators of the age of any particular portion of the Chalk sequence: in fact, his first scientific contribution was "An Analysis of the Genus Micraster" (1899) A trial in the Dover area convinced him that he had found the key to the succession and he used this in many localities and published many maps and correlating memoirs which have thrown clear light upon the lapse of time and upon geological evolution in the later Cretaceous period. His methods proved to be of use in the hands of other observers and practically the whole of the British Chalk has now been zoned and correlated, Rowe's services being not merely those of a pioneer but the generous helper and inspirer of his contemporaries and successors.

There also fell into Rowe's hands, possessed as he was of an accurate and delicate time scale, most important details with regard to the time succession of evolutionary changes in the chief types of organisms that he studied. He was able to put on record a long series of accurately observed facts bearing upon their evolution and thus made contributions to zoology as important as those which he made to geological science. It should be added, he was greatly aided by C. Davies Sherborn.

Rowe lived at the back of Margate, at Shottendane, in a most beautiful sylvan hollow. He acquired the site in 1903 and very soon developed a passion for gardening which for a time overcame all other interests. About three years ago, he suddenly dropped gardening to excavate an old Roman site, near at hand, work which he did almost entirely himself. He had a profound knowledge of Margate history and had accumulated an invaluable collection of prints and documents. He was also a student of words, having been influenced in early life by Trench's fascinating book. At one time, he was very active in local affairs and did much to raise public taste in music. He sang well in early days and his wife was an accomplished musician. Their son inherits the gift of music.

Year after year I have urged him to get back to his chalk work. We had even talked of producing a chalk atlas together. I am glad to say that his interest in geology was so far revived that only six weeks before he died, when I was about to visit him, he wrote to me that he was ill but had finished a paper on the serpulids and I hear also one on "The Great Chalk Sea," which he probably, of all men, was the most competent to picture. He had been in bad health but would not give in until the papers were written and told his medical adviser, his former partner, that he had waited to send for him until they were finished. The act was characteristic of the man—he never thought of sparing himself. It is sad that the world is ever selfish and has no way of caring for such men and providing that they use themselves with consideration and full effect: we respect genius but little until we can no longer use it. Some day, when work such as Rowe's is described in readable form, the walls of ignorance will be shattered and the wondrous beauty of the lowly organisms of which chalk is composed will be made manifest. Our present indifference to geology is little short of criminal, seeing that it is the story of our earth.

HENRY E. ARMSTRONG.

REV. F. D. MORICE.

THE Rev. Francis David Morice, well known as an authority on certain families of Hymenoptera, died at Woking in his seventy-eighth year, on September 23. Educated at Winchester, from which he passed in 1866 to New College, Oxford, he gained high distinction as a classical scholar, and in 1874 was appointed a master at Rugby under Dr. Jex-Blake. Here he remained for twenty years, retiring ultimately in 1894 to Woking, where he took a house next to his great friend Edward Saunders, and devoted himself to entomological research.

During the latter half of the years at Rugby, Mr. Morice had frequently consulted Saunders regarding his captures of local bees and wasps. The results were published from time to time (1888–92) in the *Report* of the School Natural History Society. From this time until recently Mr. Morice made numerous contributions to the literature of his subject, at first dealing mainly with the chrysids (cuckoo wasps), aculeates, and fossores, but latterly confining himself almost solely to the Tenthredinidæ (saw-flies). Here, probably, his most valuable work was done in his careful tabulation of British native species (1903–16). His conclusions were arrived at only after full discussions with continental students and an exchange of material, and it had long been his wish to gather his scattered papers in monographic form. But he had barely begun this revision when his death occurred.

Mr. Morice wielded a considerable influence, both among British and continental Hymenopterists. His knowledge of the palæarctic non-parasitic Hymenoptera, and of their distribution, was comprehensive and exact, and he had besides made several specialised studies, *e.g.* on the structure of the terebra in saw-flies. In nomenclatural discussion also his opinions were valuable, backed as they were by a sound scholarship, aware not merely of the rules but also of the elasticity in practice of classical usage. He will be remembered, however, chiefly as a consultant and helper of younger workers. A constant stream of collections, small and great, found its way to Woking for identification, and the work was never refused.

Mr. Morice joined the Entomological Society in 1889, and became its president in 1911. He was a regular attendant at entomological gatherings, and so recently as July of last year was present at the third International Entomological Congress held at Zurich; for, to the end, he greatly enjoyed the society of his fellow-workers. He also spent much time as a voluntary worker on the British Museum collections at South Kensington, to which institution he presented the important British collection formed by Edward Saunders. His own collection he bequeathed to Oxford.

J. W.

WE regret to announce the following deaths:

Mr. G. W. Lamplugh, F.R.S., lately assistant director of the Geological Survey of Great Britain, and president in 1918–20 of the Geological Society, on October 9, aged sixty seven years.

Major W. E. Marshall, Principal Medical Officer of Health to the Sudan Defence Force, formerly an assistant bacteriologist at the Lister Institute of Preventive Medicine, on September 24.

Mr. H. W. Page, consulting surgeon to St. Mary's Hospital, London, past president of the Neurological Society of London, and the author of numerous contributions to medical and surgical literature, on September 9, in his eighty-first year.

News and Views.

DURING the recent Church Congress at Southport, one day was largely engaged with discussion on the 'religion and science' issue. The most notable utterances were a sermon by Dr. Lang, the Archbishop of York, and a paper written by the late Vice-Chancellor of the University of Liverpool, the distinguished pathologist Dr. Adami, whose recent death was a grave loss to medical science. Dr. Lang directed attention to the change of outlook in contemporary science, which "is beginning to ask questions about fundamental presuppositions hitherto taken for granted, about the meaning of the universe as a whole." Science, in other words, seems to be becoming more philosophical. The Archbishop then made a strong plea that this new orientation in science should be met, on the part of the Church, by "an attitude of the fullest sympathy and trust." "The Church will not merely be detached. Its members will be ready to accept whatever truths in the region of natural science or historical criticism seem to be really established, and to welcome them as new revelations of the divine working." This must rank as a really significant utterance, and, if it speaks for the Church of England as a whole, is a most hopeful sign of the times.

DR. ADAMI's paper to the Church Congress outlined the attitude of the man of science towards faith and

the spiritual life. Three possible attitudes are indicated: (1) Negation of everything that is outside the boundaries of the senses and therefore incapable of being tested by physical means. (2) Acceptance of and belief in things of the spirit as of a world that is wholly apart from the material universe, and so from science. This was the attitude of Pasteur (under whom, it is interesting to note, Dr. Adami studied). (3) Belief that science and faith are governed by the same laws and that their methods are essentially identical. Rejecting the first two attitudes, Dr. Adami developed the third, showing how scientific knowledge advances by the use of hypotheses and the perpetual revision of theories in respect to new facts. Thus the Newtonian physics has been revised by Einstein, and Dalton's chemistry by J. J. Thomson and Sir Ernest Rutherford. The method of science is that of a search after truth by "progressive assumptions," and the search for religious truth is guided by a similar principle. It, too, is 'pragmatic,' and based on hypothesis and experiment.

DR. ADAMI'S paper was followed by one read by the Rev. J C. Hardwick, which dealt primarily with certain ethical difficulties presented by the facts of biological science, instancing the behaviour of the ichneumon wasp. He suggested that the difficulties arise from regarding Nature as a completed system rather than as an incomplete process, various stages of which co-exist and find themselves in disharmony. If Nature is to be judged, she should be judged by her latest products, *i.e.* in the light of man and his ideals, rather than by the wasp or the slug. It was refreshing to find authoritative spokesmen expressing views which cannot fail to create a new atmosphere. How far the audience realised the implications of all they heard may be doubtful. Dr Lang's allusion to the results of "historical criticism" is especially significant, for it is these, rather than the facts of natural science, which create problems for theologians to-day. Furthermore, Dr. Adami's policy of revised hypotheses would spell the end of all theological finality; though, to be sure, this might give religion a new lease of life

SIR OLIVER LODGE, on October 7, began at the Mansion House, London, a series of lectures endowed by Mr. Halley Stewart on the general theme of religion and science, with special reference to human progress. Sir Oliver said that he is impressed with the majesty and possibilities of the universe, as contrasted with the comparatively narrow outlook of the average of those engaged in the work of the world. With regard to religion and science, he does not feel oppressed by any conflict between them when both are reasonably understood. Both involve knowledge of certain aspects of the same universe, and controversies arising between them must spring from misunderstanding and limitation of outlook. As for scientific knowledge we little know whither its increase will lead us. The aspect of science which appeals to the majority of mankind is to be found in the applications and conveniences which can be derived from it. But the power to control the forces of Nature and to adapt them to our ends must depend for its value on what those ends are. The uses we now make of our increased powers may not be such as really conduce to the progress of humanity. In spite of the scientific and mechanical progress of the nineteenth century, no one can feel that we have arrived at a stable and satisfactory stage of civilisation. Though material development ought to conduce to human progress, there is no inevitable connexion between the two. Increased power over Nature involves increased power to destroy. Yet, on the other hand, if competition gave place to co-operation, and if each individual sought the welfare of the whole, the possibilities of life on this planet would be found to be such as have scarcely yet been imagined. Sir Oliver is inclined to believe that the possibilities of Christ's teaching of love and forgiveness are to-day being more clearly realised, and there will come a day when human intercourse will be saturated with it. The lecture was characteristic of the new outlook which sees that the chief problem raised by the rapid development of scientific technique is an ethical problem, and it is doubtful if this can be solved in isolation from religion.

MR. DANIEL GUGGENHEIM, the copper magnate, has given a sum of 500,000*l.* for the promotion of aeronautics. His son, Mr. Harry Guggenheim, is president, and Admiral H. I. Cone is vice-president, of the board of management of the fund. Admiral Cone was in command of the U S.A naval forces on foreign service in 1917-18, was wounded in the sinking of a British destroyer by submarine, is a Commander of the British Empire, and holds the Distinguished Service Order. Major R. H. Mayo, well known in British technical aeronautics, represents the board in Great Britain, and has assisted the president and vice-president, during a recent visit, in considering methods of applying the fund. They have come to the conclusion that the Royal Aeronautical Society is an appropriate body through which direct expenditure may be made in Great Britain towards co-ordinating international scientific and technical information, and a grant of 1000*l.* has been made for the year 1926-27. In the U.S.A. 60,000*l* has been allocated to each of two Californian institutions—the Leland Stanford University at Palo Alto and the California Institute of Technology at Pasadena—for the purpose of equipping and carrying on schools of areonautics. Prof. W. F. Durand holds the chair of engineering at Leland Stanford University, and Dr. R. A. Millikan is president of the California Institute of Technology; their names suggest a due balance between technical development and physical research

THE seventh year of the Tidal Institute of the University of Liverpool, according to the annual report for 1925 just issued, has been devoted mainly to the analysis of tidal observations and the preparation of tide tables The method devised in 1923 for the execution of such work on a large scale has been thoroughly tested, and has proved effective and in all respects satisfactory. New advances have been

made in regard to the prediction of tides in shallow waters; a request to analyse records from Avonmouth, where the shallow-water effects are extremely acute, led the secretary, Dr. Doodson, to devise harmonic corrections which are more general and more widely applicable than the non-harmonic corrections hitherto used in such cases. An entirely new problem of great importance to navigation in many regions was raised by a request of the Canadian Hydrographic Office for a method of predicting the times of turning of tidal currents, affected by large diurnal constituents, from records of such times alone; Dr. Doodson has devised such a method, which is being applied and tested. The Institute has undertaken tidal analyses or predictions for the Admiralty, the Port of London Authority, the Lower Liao River Conservancy for Newchang, the International Council for the Exploration of the North Sea, the New Zealand and Queensland Governments, and the other bodies already mentioned. A radio receiving set has been installed so that weather reports may be utilised to assist in a proposed new service of daily predictions of meteorological perturbations of sea-level at Liverpool.

THE papers read at the recent Conference of Public Lighting Engineers in Newcastle-upon-Tyne dealt with matters of professional rather than scientific interest, but there were several points mentioned that are not generally known. Mr. Colquhoon, in the course of his paper, stated that Scottish boroughs have a statutory obligation to provide proper public lighting, but there is apparently no similar obligation in England, the only legal requirement being that obstructions on roadways (such as those due to repairs) must be lighted by night. Similarly, in a paper entitled "Lighting Hours," Mr. Beveredge explained that there is no standard legal schedule of the hours for which public lamps must be lighted, each authority acts at its discretion, and there is considerable variation in the practice of different towns. It is only the drivers of vehicles who are required to exhibit lights during specified hours. There was some discussion on the practicability of a standard schedule for lighting hours, but it was suggested that at least two schedules, one for the south and one for the north of England, might be required. The possibility of compliance with a rigid scheme of lighting hours also depends largely on the facilities for lighting up and extinguishing, *i.e.* the extent to which automatic methods of control are available. The question of the lighting of important arterial roads designed for motor-traffic was also discussed. There is a general feeling that the lighting of such routes ought not to be left entirely to the discretion of the individual authorities in areas traversed, and that a portion of the Roads Fund might be applied to lighting by the Ministry of Transport, which is already interested in the maintenance of the surfaces of roads.

AUTUMN in Great Britain has this year continued generally exceptionally fine and mostly warm. In September the weather was fine and dry, the total rainfall being remarkably low in some southern districts; Southampton had a total of only a quarter of an inch. The weather was very warm in the third week of September, the thermometer in the shade registering 88° at Greenwich on September 19, and in many places the highest temperature of the year was experienced. In the south-east of England, the mean temperature for the month was about 4° above the normal. There were four days during the month at Greenwich with the solar radiation temperature above 140°. For the first three weeks there was not a single day with the mean temperature below the average. There was a considerable drop of temperature after September 25. Some October temperatures during the first ten days of the month touched 70°, mostly registering about 65°; in 1921, five years ago, October was remarkably fine and warm, the thermometer at Greenwich exceeding 80° on several days in the early part of the month. There was a break on Saturday, October 9, due to the arrival over Great Britain of a vigorous secondary disturbance from the Atlantic, and gales were experienced in places on the coasts, with heavy rain showers in places. Colder weather spread over the country in the rear of the disturbance and the conditions became more normal for the season of the year.

THE inaugural address at the opening of the eighty-fifth session of the School of Pharmacy of the Pharmaceutical Society was delivered on October 6 by Dr. J. F. Tocher, of the University of Aberdeen. In the course of his remarks, Dr. Tocher commented on the possible reasons which lead to the adoption of pharmacy as a career, and hoped for the time when students of all kinds might be classified according to their ascertained intelligence, so that their teachers would be able to impart knowledge to them more successfully. But such tests would scarcely distinguish between those who favoured pharmacy as a profession and others whose thoughts turned towards different careers. With increasing knowledge, the training of the pharmacist becomes more arduous: the rapidly expanding list of drugs used in medicine requires knowledge of their properties and uses, and of the tests necessary to ensure their purity. In the Pharmacological Laboratory which the Society has recently opened, the student will be able to gain first-hand experience in the testing of those drugs which require for their assay the use of animals. Thus although the minimum standard of knowledge has been raised with the advance in knowledge in the other sciences, the enthusiastic student will find ample opportunity not only to reach this standard but also to progress beyond it.

A REPORT by Prof. J. Borozdin, quoted by the Riga correspondent in the issue of the *Times* of October 8, gives a brief account of the results of excavations carried out by Prof. Farmakovsky in the neighbourhood of Nikolaieff, where he has been working for the last twenty years, on the site, hitherto not identified, of the Milesian colony of Olbia (which was described by Herodotus), at the mouth of the River Bug. The excavations now embrace an area of 287,000 sq. yd., not including a necropolis, and the objects brought to

light include dwellings, temples, and vaults. In the centre of the town stand the ruins of a temple of Apollo. Nine successive strata of remains have been discovered; these show a variety of influences from several sources, including Attica and the Roman Empire as well as Miletus. Of even greater interest are the excavations at the village of Usatoff, some five miles out of Odessa. Here a culture has been found which is said to exhibit the transition from neolithic to bronze and to be advanced of its type. It is that of a settled agricultural community with earthen dwellings closely resembling the culture of Tripolje. The pottery is of the characteristic painted type, having strong points of resemblance to the widely diffused painted pottery which, with wide divergences and of varying epochs, it is true, is found in China, central Asia at Anau, India, Elam, Mesopotamia, Cappadocia, and Syria, and in Europe in southern Russia, Rumania, Bulgaria, Thessaly, and southern Italy. An example is said to have been discovered in the Crimea. Further information will no doubt confirm the importance of the discovery, which should serve to throw additional light on the difficult question of the relationship and lines of diffusion of this remarkable type of prehistoric ware.

THE Trueman Wood Lecture of the Royal Society of Arts will be delivered on October 27 at 8 P.M. by Dr. R. J. Tillyard, chief of the Biological Department of the Cawthron Institute of Scientific Research, Nelson, New Zealand, who will take as his subject "The Progress of Economic Entomology."

THE James Forrest Lecture for 1926 of the Institution of Civil Engineers, which was to have been given in May, will be delivered at the Institution on Tuesday, October 26, at 6 o'clock, by Senator G. Marconi, who will take as his subject "Radio Communications." Before the lecture, the Kelvin Medal for 1926, which has been awarded by the Kelvin Medal Committee to the Hon. Sir Charles A. Parsons, will be presented to him by Sir William Ellis, president of the Institution.

PROF. HANS THIRRING, professor of physics in the University of Vienna, will deliver a lecture in English on October 19, on "The Position of Science towards Psychical Research," at the National Laboratory of Psychical Research, 16 Queensberry Place, South Kensington, London, S.W.7. This lecture is one of a series arranged for the season 1926–27, which includes one by Mr. Stanley de Brath on "Animism, Spiritism and Spiritualism" (February 15), and another by M. René Sudre (in English) on "Psychical Research and Psychology" (March 15).

THE three Cantor Lectures on thermometry which have been given by Mr. W. F. Higgins of the National Physical Laboratory to the Royal Society of Arts are reproduced in the issues of the *Journal* of the Society for September 3, 10, and 17. They furnish the best account available in English of the properties and behaviour of the mercury-in-glass thermometer, of the methods used in its standardisation, and of the precautions to take in order to obtain the most accurate results from it. Mr. Higgins looks forward to the time when the mercury-in-silica thermometer will be substituted for the mercury-in-glass thermometer for all accurate work.

THE seventy-ninth annual meeting of the Palæontographical Society was held at Burlington House on October 1, Dr. F. A. Bather, vice-president, in the chair. The annual report announced the completion of Miss Chandler's monograph of the Upper Eocene flora of Hordle, and the early issue of further instalments of the monographs of Gault Ammonites, Malacostracous Crustacea, and Palæozoic Asterozoa. The council appealed for the help of more personal subscribers, the larger number of the supporters of the Society being now public institutions. Prof. W. T. Gordon, and Messrs. G. Barrow, A. T. Hopwood, and J. Pringle were elected new members of council. Mr. E. T. Newton was re-elected president, and Mr. Robert S. Herries and Sir A. Smith Woodward were re-elected treasurer and secretary respectively.

THE council of the Institution of Civil Engineers has made the following awards for the session 1925–1926 in respect of selected engineering papers, published without discussion: A Telford Gold Medal and the Indian Premium to Mr. C. R. White (London); a Telford Gold Medal to Mr. E. L. Everatt (Bombay); and Telford Premiums to Dr. B. Hague (Glasgow); Prof. A. H. Gibson (Manchester) and Mr. S. Labrow (Bury) jointly; and Dr. W. J. Walker (Johannesburg). The following awards have been made in respect of papers read at students' meetings in London or by students before meetings of local associations during the same session: The James Forrest Medal and a Miller Prize to Mr. D. S. Matheson (London); and Miller Prizes to Mr. H. R. Lintern (Shepton Mallet), Mr. R. D. Carr (Cupar), Mr. C. Peel (Frodsham), Mr. R. S. Bamber (Leeds), Mr. N. R. Rice (Dar-es-Salaam), Mr. J. G. Kimber (Eastbourne), and Mr. J. B. Mayers (Birmingham).

THE Earl of Balfour presided at a congregation at Cambridge on Tuesday, October 5, when the University commemorated the three-hundredth anniversary of the death of Francis Bacon, Lord Verulam, by awarding honorary degrees to the Cavendish professor of physics, Sir Ernest Rutherford, and to Prof. W. S. Holdsworth, Vinerian professor of English law in the University of Oxford. The public orator spoke of Bacon, eminent in civil law and natural science, as a follower of the Stoics, who taught us to strive to adjust our laws to the laws of Nature; Dr. C. D. Broad, Trinity College, who lectured to the University on Bacon, described him as the father of inductive philosophy, one who discovered and explicitly stated the methods and principles of scientific research, which his successors have used with success. An afternoon reception was given by Trinity College and a dinner in the evening, at which the Earl of Balfour spoke to the toast of Bacon's memory.

A RECENT issue of the *Weekly News Bulletin* of the U.S.S.R. Society of Cultural Relations with Foreign Countries contains under the heading "Scientific

Life" an account of measures recently adopted for encouraging intellectual activity. The title "merited" has been established, to be conferred for distinguished service by scientific and technical workers. Money premiums are to be given for inventions and suggestions, even though they may not directly result in the saving of expenditure. Instances of pensions for prominent services in science are also mentioned. Under "International Cultural Relations" are reports of visits to Russia by Profs. Erlander of Stockholm, Wiegond and Rodenwald of Berlin, and Temer of Strasbourg, and visits to Egypt by the Rector of the Russian Hydrological Institute to take part in the International Navigation Congress at Cairo, and to the Balkan countries and Italy by N. P. Sycher of the Russian Academy of History of Material Culture.

WE have received from Messrs. Stafford, Allen and Sons, Ltd., Cowper Street, Finsbury, London, E.C. 2, a sample of 'Sira' immersion oil and of 'Sira' mountant. Originally produced as a result of researches conducted at the British Scientific Instrument Research Association, these products are now prepared by the manufacturers in accordance with the directions of the Association. The refractive index of the immersion oil (1·524 at 20°) is adjusted to suit modern high-power object glasses, condensers, and micro cover glasses. An important feature of the oil is its freedom from corrosive action on metals or on optical glass. 'Sira' mountant, being quite neutral, may be advantageously used in place of Canada balsam, the acidic properties of which are known to affect certain stains and other substances when mounted in it. These 'Sira' products, which may be obtained from all scientific instrument makers and dealers, should prove of considerable value to microscopists whose work demands critical observation, in assisting them to obtain the best possible results from their microscope and its accessories.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A pathologist for the City of Nottingham—The Town Clerk, Guildhall, Nottingham (October 18). A junior inspector of mines for North Wales (Lancashire and North Wales Division)—The Under-Secretary for Mines, Establishment Branch, Mines Department, Dean Stanley Street, S.W.1 (October 25). A mycologist under the Ceylon Rubber Research Scheme—The Private Secretary (Appointments), Colonial Office, 38 Old Queen Street, S.W.1 (January 1). A lecturer in physics in the University of Otago, New Zealand—The High Commissioner for New Zealand, 415 Strand, W.C.2. A junior technical officer at an Admiralty Experimental Establishment, with good theoretical and practical manufacturing knowledge of the design of electrical apparatus—The Secretary of the Admiralty (C.E. Branch), Whitehall, S.W.1. A lecturer in mechanical engineering at the School of Science and Art, Newark-on-Trent—The Secretary, Old Magnus Buildings, Appleton Gate, Newark-on-Trent. A junior mathematical mistress—subsidiary subjects geography and botany—at the Southport High School for Girls—Application forms from the Director of Education, Education Office, Southport, but returnable to the Headmistress.

Our Astronomical Column.

MINOR PLANETS.—Vol. 9, No. 9 of the *Journal des Observateurs*, contains a study of the orbit of No. 117 Lomia by M. Henri Blondel. This covers the period from 1913 to 1925, and includes the perturbations by Jupiter and Saturn. A good agreement with observation is obtained. It is noted that observations over a period of some four months are required to obtain a good orbit from a single opposition. It is suggested that ephemerides should be extended over a longer range than is usually done.

This is a favourable time for observing the interesting planet 132 Aethra, which was recovered a few years ago after being lost for half a century. It is in high north declination and of magnitude 11. Ephemeris for 0^h by H. Hartog (*Astr. Nach.* 5464):

	R.A.	N. Decl.
Oct. 16	$3^h\ 33^m\ 16^s$	$41°\ 16'$
„ 28	3 23 36	40 30

ANOTHER DETONATING FIREBALL.—Mr. W. F. Denning writes that a very large meteor was visible on the evening of Saturday, October 2, at $19^h\ 25^m$ G.M.T. As observed at Bristol, its path was from $330° - 7°$ to $34° + 14°$. A considerable number of observations have been received, and a comparison of these shows that the object passed from over the English Channel (45 miles south of Brighton), northwards over the western suburbs of London, and on to the northern region of Hertfordshire, where it exploded at a height of about 11 miles. The radiant point was in Capricornus at $305° - 13°$. The velocity of the fireball was about 13 miles per second along a real course of about 125 miles. The nucleus was green, followed by red sparks. The weather being generally clear in the south of England, the phenomenon was pretty generally witnessed, though observers differ materially in their impressions concerning it. The radiant of the fireball agrees with that of a well-known shower in July and August.

C. SCHOCH'S RESEARCHES ON ANCIENT ECLIPSES.—Allusion has already been made in these columns to Schoch's conclusions on the eclipse of the Odyssey, which he identified as that of April 16, B.C. 1178. He has now discussed a still more ancient eclipse, that in the tenth year of the Hittite king Mursilis II. He identifies this as the annular eclipse of B.C. 1335, March 13, which was central in the region of the Azzi (about Erzeroum). The total eclipse of Jan. 8, 1340, is excluded, since military operations would not take place so early in the year in that elevated region. Schoch notes that the region is the same as that afterwards traversed in the retreat of the Ten Thousand. He has also identified various eclipses mentioned by Greek poets:

Poet.	Date B.C.
Mimnermos, same as eclipse of Thales	May 28, 585.
Stesichoros and Kydias. . . .	May 19, 557.
Agathokles eclipse, concluded position of Agathokles in Straits of Messina	Aug. 15, 310.

Research Items.

THE ORIGIN OF THE MASAI AND THE WILD TRIBES OF BORNEO.—In the *Journal of the East Africa and Uganda Natural History Society*, No. 26, August 1925, Mr. C. Cardale Luck puts forward a theory that the Masai and related tribes of East Africa are the ancient Israelites, while the wild tribes of Borneo, the Kenyah, Kayan, Punam, etc., are the ancient Edomites. Merker's theory of the Semitic origin of the Masai, it is pointed out, might have been extended to identify them with the ancient Israelites, had it not been conditioned by the view that if their route of migration was through the Nile valley, it must have taken place in the prehistoric period before the Egyptian settlement. The historical evidence, however, points to the possibility of a movement of Asiatic peoples in the required direction in Egyptian historic times in the influx of Semitic peoples after the Hyksos period, the transference of captives after the Egyptian conquests, the flight of such of the Israelites as were not carried off into Assyria before the victorious armies of that power, and the desertion into Ethiopia of mercenaries, presumed to be Asiatic, under Psamtek and Tanutamen of the Nubian dynasty. Looking at the evidence afforded by the Masai and kindred tribes, distribution of language clearly suggests a north to south movement. The religion of the Masai, a trinity of Engai, a feminine supreme deity, and two inferior deities, a black or good god and a red or evil god, points to an original mother goddess worship, ultimately of Asiatic origin The Canaanites in passing through Egypt confused her with Hathor, the minor gods of the Masai being Osiris and Set. Tribal names of the Masai also point to Canaan, Ma-a-sae, L'Aiser and Gidon being equated with Ma-na-say, Je-ezer, and Gideon. Similar equivalences are found in the Bornean religion, belief, and nomenclature and pointing to a Canaanitish origin

SICKNESS, DEATH AND BURIAL AMONG THE MAORI.—Notes from a native source in the original and in translation relating to the ritual of death and burial among the Maori of New Zealand are given by Mr Elsdon Best in the *Journal of the Polynesian Society*, Vol. 35. No 1, which contain certain data not hitherto recorded, and some interesting formulæ. In former times there was little ritual pertaining to burial, and indeed the ceremonies performed over a sick person were more elaborate, possibly owing to the fact that the custom of exhumation and final disposal of the remains was looked upon as the real burial. There were several ritualistic performances by which the shamanistic adepts diagnosed the cause of illness. This was usually either black magic or infringement of the laws of *tapu*. The ceremony here quoted, for a chief seized with severe illness, involved the use of formulæ absolving a person from the polluting effect of all immoral or wrongful acts committed from childhood up to that time. The dead were usually disposed of by inhumation, but sometimes they were merely placed in a cave The body was flexed before it was cold, the knees being drawn up to touch the trunk and bound with a cord. In a few cases it was exposed to a rude drying process. The exhumation took place some years, sometimes so many as eight, after the first burial, although, as a number of exhumations took place at one time, there must have been considerable variation. The function was one of remarkable *tapu*; it involved the employment of adepts and was carried out with an elaborate ritual; the final destination of the remains was a cave, fissure, or hollow tree. Great care and skill were exercised in removing the bones, especially in recovering the small bones. Articles placed with the dead such as weapons and ornaments, both at the primary and secondary burials, were sometimes recovered for the relatives by a priestly adept, with the performance of certain ceremonial observances.

ALIEN PLANTS IN THE ISLE OF WIGHT.—The bulk of vol. 1, part 5 of the *Proceedings of the Isle of Wight Natural History Society* for 1924 is occupied by a list of the alien plants of Hampshire and the Isle of Wight, by John F. Rayner. The list is a very long one and has obviously been in compilation for some years, the author being helped by a number of local botanists, as well as by veteran systematists, as Dr. Claridge Druce.

AN ANTARCTIC FLORA.—The Australasian Antarctic Expedition, 1911–14, has recently published as vol. 7, part 5, some beautiful photographs of the very characteristic flora of Macquarie Island, which were not available when the late Mr. F. T. Cheeseman prepared his report on the vascular flora of Macquarie Island, owing to the disturbance of personnel and records of the expedition brought about by the War. The photographs of *Pleurophyllum Hookeri*, of *Stilbocarpa polaris*, and of such cushion plants as *Azorella selago*, are of great ecological value, some photographs giving detail of individual plants beautifully, whilst others show in a striking manner their characteristic distribution on this wind-swept antarctic island. All the conspicuous members of the flora are represented photographically in these 19 plates, while Mr. Harold Hamilton supplies brief notes on the ecology.

PENTOSANS AND COLD RESISTANCE IN PLANTS.—Of recent years, American workers, especially J. T. Rosa and Victor R. Boswell, have tried to establish a connexion between the pentosan content of certain plants and their resistance to frost damage. The underlying assumption has been that the water-imbibing properties of the colloidal pentosans have enabled these plants to retain the water in this form and thus resist the tendency to ice-formation and consequent protoplasmic disorganisation. Arguing further that the retention of water by imbibition by the pentosans should be effective against force of dehydration, Rosa compared the transpiration rates and rates of drying of cold resistant and non-resistant plants. Both Rosa and Boswell agree that the hardened plants lose water more slowly under comparable conditions, and suggest in fact that this property provides a simple test, in horticultural practice, of the relative hardiness of a plant. This attractive theory comes out very badly from a thorough investigation by Prof. Doyle and Miss Phyllis Clinch, of the Department of Botany, University College, Dublin, who have tested its application to evergreens, and particularly conifers. In conifers they conclude (*Scientific Proceedings of Royal Dublin Society*, vol. 18 (N.S.) No. 21, 1926) that no relation, seasonal or otherwise, can be established between hardiness and pentosan content. Furthermore (same *Journal*, No. 24, 1926), they show that the rates of drying show no relation to pentosan content, and on physico-chemical grounds there seems little reason to expect any other result, whilst until Rosa and Boswell have repeated their drying experiments with chopped-up tissues, there is little or no reason to assume that pentosan content has any connexion with the differences in drying shown by hardy and non-hardy varieties.

MINERALS FROM THE RUBY MINE DISTRICT OF BURMA.—A notable contribution to the mineralogy of Burma is published by F. D. Adams and R. P. D. Graham in the *Trans. Roy. Soc. Canada*, Section 4, 1926, p. 113. Between the Irawadi and Mogok the exposures show alternating bands of gneiss and coarsely crystalline limestones which recall the sections through the Grenville series of the Canadian Shield. Half way along the road to Mogok a large intrusive body of granite occurs with an enormous pegmatite dyke near its eastern border. The dyke is made up mainly of kaolinised orthoclase and quartz, the latter being often in large transparent crystals Lepidolite crystals up to six inches across are described, and muscovite, topaz and cassiterite. An interesting nepheline-sodalite rock occurs at Mogok, the sodalite from which has a beautiful deep lilac colour. The colour fades on exposure to light, and disappears immediately when the mineral is slightly warmed, this being a characteristic of all pink sodalite. A nepheline-ægerine-augite rock (urtite) was found at Sinkwa, 13 miles from Mogok. Both nepheline rocks resemble very closely varieties occurring in the Bancroft district of Ontario, and afford additional examples of the common association with crystalline limestones. Other minerals described are chrysoberyl, sillimanite and forsterite from Mogok. A more detailed description of the geology of this part of Burma, together with an account of the methods adopted in working the deposits for rubies, was given by Prof. Adams in the *Bull Canadian Inst. Min. Met*, 29, Feb. 1926.

PLATINUM IN SOUTH AFRICA.—In *Economic Geology*, Nos. 2 and 3, 1926, Dr. P A. Wagner gives a very full account of the occurrence of platinum in the Transvaal and Southern Rhodesia. As the chief deposits have already been noticed in NATURE, attention is here directed to the genetic considerations with which Dr Wagner concludes his study. Concentrations of platinum are more widely distributed in South Africa than in any other part of the world, and the platinum-bearing rocks have been produced in practically all the periods of igneous activity from the earliest Archæan onwards From the Vaal River to the Zambezi the principal deposits are confined to a narrow meridional belt that cuts indiscriminately across all the other structural features Some deeply underlying region must therefore have contributed the ores, suggesting that the *sima* or peridotite zone beneath South Africa is, or has been, unusually richly endowed with platinum J. E Spurr has already advocated the idea of great *ore canals*, stable throughout geological time, from which igneous magmas have abstracted ores and, ascending in the crust, have concentrated the metals nearer the surface. Dr Wagner similarly conceives the presence below the platinum belt of a great platinum-rich canal which has provided the material transferred towards the surface by successive igneous intrusions. It is also pointed out that there is an equally remarkable gold province in south-east Africa which may well have drawn its gold from the same canal It is worthy of notice that if the hypothesis be true in the form in which it is advocated by Spurr and Wagner, it raises a most serious objection to the migration of continents over the substratum that has been envisaged by Wegener, and somewhat differently by Joly. On the other hand, the conception itself is in accord with the inference drawn by Holmes (from the atomic weight of lead) that lead ores must have had some source independent of any later concentration from the magmas of igneous rocks. Another point is that no ore deposits are found in oceanic islands, suggesting that the continental rocks are more probably the original home of most ores rather than the underlying *sima*. If this be so, then the ore canals may represent concentrations produced in and near the bases of the continents at the time of their origin. If, then, the continents moved laterally in later ages, the canals would be carried with them, and not left beneath and behind as they would otherwise be.

TIDES AND SEA SEICHES.—Tidal features of local coastal origin and sea seiches are discussed by Prof. J. Proudman in a recent *Geophysical Supplement* (vol. 1, No. 6, 1925) of the *Monthly Notices of the Royal Astronomical Society*. The paper is illustrated with many diagrams of cotidal lines relating either to actual regions or typical ideal cases (curved and rectangular capes and bays, circular and elliptic islands, and a passage between two seas). Deductions as to the deformation of the cotidal lines by such local features are made on a mathematical basis, and actual cases of the phenomena are instanced, on the British or Irish coasts. The effect of the neighbouring coast-line on sea-seiches in a narrow bay is also considered.

IRRIGATION IN INDIA.—A review of irrigation in British India during 1924–25 has been published by the Public Works Branch of the Department of Industries and Labour. During the year the monsoon, after beginning weak, was practically normal in total rainfall, and there was appreciable defect only in Orissa and Kashmir, with excess in the western United Provinces, the North-West Frontier, Rajputana, and Malabar. The total area irrigated by works of all kinds was 27·2 million acres, which was about a million acres less than in the record year 1922 23. It is of interest to note that 12·4 per cent. of the total cropped area was irrigated by Government works. The review gives full details of the financial side of irrigation and drainage works during the year.

PRESSURE AND WINDS OVER THE CHINA SEA.—A large-scale atlas of twelve maps showing the mean atmospheric pressure and wind direction and force over the China Sea for each month of the year has been published under the authority of the Governor of Hong-Kong. There is a short introduction by the Director of the Royal Observatory, Hong-Kong. The observations were collected during the years 1900–1912 from ships calling at Hong-Kong, the stations of the Chinese Maritime Customs, and various observatories in the Far East. The observations were originally tabulated in one-degree squares, but this grouping being found unjustifiable except on the main sea routes, they were collected into two-degree squares. Pressures are shown in inches, wind forces are given on the Beaufort scale, and within the wind roses are given the number of barometric observations on which each has been determined and the percentage of calms. The maps extend to lat. 34° N., 8° S., and long 130° E. They are clearly printed, with land outlines in blue and isobars in red.

X-RAY EXAMINATION OF LONG-CHAIN COMPOUNDS.—In the *Annales de Physique* for July-August, M. Trillat contributes an important paper on the X-ray examination of long-chain compounds, and he gives values for the spacings of fatty acids containing as many as 32 carbon atoms. With the new data at his disposal he shows that the rate of increase in chain length with increase in the number of carbon atoms is slightly different for acids containing odd and even numbers of carbon atoms, although it is uniform in both cases. He also finds that by mounting a thin layer of a fatty acid on a strip of metal, a very fine

film of soap is usually formed immediately in contact with the metal surface. This film is amply sufficient for the purposes of X-ray examination by the reflection method, so that it is unnecessary, in general, to prepare a soap separately for X-ray examination. By examining the changes in the X-ray spectra of oleic, linoleic and linolenic acids in the course of drying in air, Trillat is the first to follow directly a complex chemical reaction by means of X-rays. Attention is directed to the importance of these long-chain compounds in the investigation of very soft X-rays.

THE PHYSICAL PROPERTIES OF GLASSES.—A large amount of information on the above subject is to be found in Prof. W. E. S. Turner's lecture on the relationship of the physical properties of glasses to chemical composition and mode of preparation, delivered before the Chemical Society on April 29, and published in the Society's *Journal* for August last. The preparation of commercial glass involves the fusion of a number of oxides or metallic salts, which may number as many as twelve or more, and the proportions of the constituents largely determine the physical properties. The most important properties are the transmission and absorption of light, the refractive index, the viscosity, the annealing temperature, electrical conductivity, and resistance to the action of water (which is partly a chemical process), thermal expansion and density. In many cases simple relationships are found which make it possible to prepare glasses of approximately known properties by fusing suitable oxides in the requisite proportions. A compromise is necessary in the manufacture of glass for chemical purposes, since the presence of alkaline oxides reduces the resistance to the action of acids. Modern chemical glass ware contains a high percentage of silica, with boric oxide and alumina, and only sufficient alkaline oxides to enable melting to take place fairly readily. The use of a high percentage of silica lowers the resistance of the glass towards alkalies, but the danger of breakage from sudden temperature changes is eliminated on account of its low thermal expansion.

THE USES OF TELLURIUM.—On account of its many industrial applications, tellurium is rapidly becoming of technical importance. Some notes on its uses are contained in a short article in the *Chemical Trade Journal* for September 10, and among the most important are: as a colouring agent in the glass and porcelain industry, in the preparation of organic dyestuffs, in the manufacture of electrical equipment, high resistance alloys and ultramarine, in the colouring of lithophone and the staining of silver, as a delicate test of sterilisation in bacteriology, and as a toning agent in photography. A compound of tellurium has been patented as an anti-knock constituent of motor fuels, and its use is said to lead to greater efficiency. Remarkable properties are shown by the alloys of tellurium; the tin alloys are extremely hard and have very great tensile strength, the aluminium alloys are very ductile, while the silver alloys have recently been used. The poisonous properties of the element, and its fairly ready absorption (*e.g.* from gold dental stoppings), are not mentioned in the article, but should not be overlooked.

LOW TEMPERATURE CARBONISATION.—The firm of Salermo Ltd., 17 Kingsway, London, W.C.2, has issued a brochure entitled "Low Temperature Carbonisation and the Salermo Process." It contains mainly a survey, sound in substance and temperately worded, of the processes hitherto proposed. The Salermo retort, which is new to Great Britain although tried already in the Sarre mines, is described. It consists of a series of troughs fixed adjacently and parallel and heated from below. The coal, pre-dried by waste heat, is mechanically propelled from one trough to the other, and the product is delivered in a semi-pulverised condition. High throughput is said to be associated with low capital and running costs. The product is, unfortunately, not fit for immediate domestic consumption, but might be suitable for steam boilers.

PROJECTION OF EXPLOSIVE FLAMES.—In a paper published by the Safety in Mines Research Board (No. 27) Mr. M. J. Burgess has described experiments on the distance over which a methane-air mixture, when exploded in a tube, projects its flame into the air filling a second tube attached to the explosion-tube. When the two tubes were 9 cm. in diameter the projection of flame into the air may be more than five times the length of the original column of explosive mixture. When the aperture between the two tubes is gradually reduced by an adjustable diaphragm, the first effect is an increase in the length of the projected flame—especially with mixtures containing an excess of methane. The experiments show to what a great distance flame may be projected along a gallery when a fire-damp explosion occurs in a mine.

SMOKELESS FUEL FOR POWER.—At the Conference on Smoke Abatement held at Birmingham recently, Mr. A. S. E. Ackermann read a paper on the "Engineering Aspects of the Smokeless Production of Power," a copy of which we have received. The various methods of generating power without smoke production are surveyed briefly. Pulverised fuel firing of steam boilers is favoured on account of high thermal efficiency and absence of smoke. The common view that water-power resources of Great Britain are negligible is contested. It is calculated that 500,000 H.P. might be developed by the erection of efficient installations. The combination of public hot-water supply with power stations is a means of increasing the thermal return of electricity generation. The waste heat from gas retort settings might be utilised to generate current in large quantities. Mention was made of the application to marine and locomotive work of the Still (internal combustion steam) engine, which now is the most efficient prime-mover available.

COAL TREATMENT IN THE UNITED STATES.—In the September number of the *Journal of the Franklin Institute* appears a series of papers on low temperature carbonisation, read at the "Oil and Gas Power Week" Conference at Philadelphia in April last. They reflect the growing concern as to the uncertainty of adequate supplies of mineral oil across the Atlantic. H. W. Brooks gave a general summary of European and American processes, and although unable to point to successful commercial achievement anywhere, he closed on a note of confidence that we are nearing the "Age of Coal Processing." W. H. Blauvelt read another general paper emphasising the desirability of subjecting coal to a process of fractionation and refinement analogous to that of the mineral oil industry. Perhaps the most interesting contribution technically was made by V. Z. Caracristi, who gave an account of experiences with the ingenious lead-bath carbonisation process which has aroused so much interest. This has been given trial by Henry Ford at his motor-works, where no expense has been spared in grappling with the problem of this pioneering effort. To those who speak lightly of the scientific treatment of coal, it may be a revelation to learn that already several million dollars have been spent on experiments on this one process. It is not clear whether commercial success is claimed, but it is stated that the practicability of the lead-bath as a medium for the transfer of heat has been fully demonstrated.

Forthcoming Books of Science.

Agriculture, Forestry, and Horticulture.

Ernest Benn, Ltd.—The Growth, Cultivation, Manufacture and Marketing of Sugar Beet, R. N. Dowling. *Thornton Butterworth, Ltd.*—The Fruit Garden, A. J. Macself. *Cambridge University Press.*—The Physiology of Reproduction in the Cow, J. Hammond. *Chapman and Hall, Ltd.*—Manures and Manuring, F. E. Corrie. *G. Duckworth and Co., Ltd.*—The Scientific Feeding of Animals, Prof. O. Kellner, translated by Dr. W. Goodwin, new edition. *Gurney and Jackson.*—The Stockfeeder's Companion, J. Porter. *His Majesty's Stationery Office.*—Recent Progress in Agricultural and Horticultural Science in the United Kingdom, V. E. Wilkins. *Longmans, Green and Co., Ltd.*—Shorthorns: their Origin and Development, 1780–1890, W. Graham; Soil Conditions and Plant Growth, Sir E. John Russell and Members of the Biological Staff of the Rothamsted Experimental Station, new edition. *McGraw-Hill Publishing Co., Ltd.*—Breeding and Improvement of Farm Animals, Rice; Manual of Plant Diseases, Heald. *Oxford University Press.*—The Rural Industries of England and Wales. A Report of a Survey made on behalf of the Agricultural Economics Research Institute, Oxford. 1: Wood Industries and some Village Workshops, H. E. FitzRandolph and M. D. Hay; The Financial Return from the Cultivation of Scots and Corsican Pines, W. E. Hiley; The Economics of the Production of Grade A (Tuberculin Tested) Milk, V. Liversage. *Sir Isaac Pitman and Sons, Ltd.*—Fertilisers, H. Cave. *L. Reeve and Co., Ltd.*—Trees and Timber, A Popular Glossary of Terms, F. Tiffany. *Sheldon Press.*—A Simple Guide to Rock Gardening, Sir James L. Cotter.

Anthropology and Archæology.

Thornton Butterworth, Ltd.—A History of the Pharaohs, A. Weigall, vol. 2: The 12th to the 18th Dynasties. *Cambridge University Press.*—Our Early Ancestors, M. C. Burkitt; Sardis. Publications of the American Society for the Excavation of Sardis, vol. 10, Terracottas, Part 1, Architectural Terra-cottas, T. L. Shear; A Comparative Study of the Melanesian Island Languages, S. H. Ray. *G. Duckworth and Co., Ltd.*—Ancient Cities and Modern Tribes: Exploration and Adventure in Maya Lands, Dr. T. Gann. *G. G. Harrap and Co., Ltd.*—A History of Hebrew Civilisation, Prof. A. Bertholet, translated by Rev. A. K. Dallas; The Primitive Races of Mankind, Prof. Max Schmidt, translated by Rev. A. K. Dallas; The Culture of Ancient Greece and Rome, Profs. F. Poland, E. Reisinger, and R. Wagner, translated by J. H. Freese. *W. Heinemann, Ltd.*—The City of the Sacred Well, T. A. Willard. *Macmillan and Co., Ltd.*—People of the Veil, being an Account of the Habits, Organisation, and History of the Wandering Tuareg Tribes which inhabit the mountains of Air or Asben in the Central Sahara, F. Rennell Rodd; Natural Man. A Record from Borneo, Dr. C. Hose. With a Preface by Prof. G. Elliot Smith; A Short History of Marriage, Prof. E. Westermarck. *Methuen and Co., Ltd.*—Primitive Culture in Italy, Prof. H. J. Rose; The Mystic Rose: a Study of Primitive Marriage and of Primitive Thought in its bearing on Marriage, E. Crawley, new edition, revised and much enlarged by T. Besterman, 2 vols. *Oxford University Press.*—A History of the Ancient World, vol. 1: The Orient and Greece, M. Rostovtzeff, translated by J. D. Duff; Apes and Men, H. Peake and Prof. H. J. Fleure; Religion and Art in Ashanti, R. S. Rattray, with chapters by G. T. Bennett, V. Blake, H. Dudley Buxton, R. R. Marett, and Prof. C. G. Seligman. *Kegan Paul and Co., Ltd.*—The Civilisation of the South American Indians, with special reference to their Magic and Religion, R. Karsten. With preface by Prof. E. Westermarck; Sex and Repression in Savage Society, Dr. B. Malinowski; The Father in Primitive Psychology, Dr. B. Malinowski; Myth in Primitive Psychology, Dr. B. Malinowski. *Charles Scribner's Sons.*—The Pulse of Progress, with a Sketch of Jewish History, E. Huntington.

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Philosophy and Psychology.

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University and Educational Intelligence.

THE twenty-fifth session of the work of the Sir John Cass Technical Institute was inaugurated on October 4, when an address was delivered by Alderman Sir Charles Wakefield, Bart. Before calling upon Sir Charles to deliver the inaugural address, the chairman of the Governors, the Rev. J. F. Marr, referred to the resignation of Dr. Keane, who had been principal for almost a quarter of a century, the appointment of Mr. Geo. Patchin as his successor, the generous support given to the work by the important companies connected with the fermentation and petroleum industries, and the gratifying record of university successes; one student has been awarded a D.Sc. for a thesis on research work carried out in the department of chemistry. Further facilities for study are being provided during the session, including a more advanced course of lectures in colloids and an advanced course of lectures on petroleum technology.

ONE of the papers read at the recent conference at Balliol College, Oxford, of the Association of Special Libraries and Information Bureaux was entitled "Instruction in Bibliographical Technique for University Students," by Mr. Harold E. Potts, chairman of Convocation of the University of Liverpool. He urges that all students should be given some instruction in the art of using a library intelligently. It is not intended that they should spend the time when they should be working in the laboratories in reading in the library, but that they should acquire the habit of looking for the original sources of the information given in lectures and text-books. This matter is largely in the hands of the professors, who would do well, from time to time, to recommend their pupils to read certain original papers as an example of how discoveries are made. The habit of looking at original papers instead of at text-books and abstracts is one that cannot be acquired too early. The student will be astonished to find that some mis-statements have been quoted from text-book to text-book throughout long periods before the error was discovered. At the same time it must be confessed that a student may easily spend too much time in this way to the neglect of experimental work.

WHILE the universities and university colleges in Great Britain usually possess good libraries, the technical institutes and colleges are, as a rule, very poorly supplied. In most cases the sums allowed for the upkeep of their libraries are very small. Principal J. F Hudson, of the Huddersfield Technical College, in a paper contributed to the recent Conference of Special Libraries and Information Bureaux at Balliol College, Oxford, argues that the provision of a suitable supply of literature should be regarded as an essential part of the equipment of every scientific and technical department of a college. Most local colleges specialise in one or more departments, such as woollen textiles, rubber technology, or pottery. These schools should develop special libraries of peculiar value which should be made accessible to all who are interested in these subjects. Principal Hudson suggests that at least 1 per cent. of the annual expenditure on a technical institute should be assigned to the support of the library. He refers to a letter in NATURE for May 22, 1926, in which a correspondent asks what he can do with old scientific books which he no longer needs. As will be seen from Mr. Headicar's letter in our issue of July 3, the Universities' Library for Central Europe has taken up this problem and has arranged to act as a clearing house for the disposal of scientific periodicals.

Contemporary Birthdays.

October 15, 1884. Prof. Lewis Knudson.
October 16, 1859. Prof. James Playfair McMurrich.
October 17, 1872. Sir Cyril Reginald S. Kirkpatrick.
October 19, 1856. Prof. Edmund B. Wilson, For. Mem. R.S.
October 20, 1862. Prof. Thomas Hastie Bryce, F.R.S.
October 22, 1876. Prof. Harold Hilton.

Prof. KNUDSON, who occupies the chair of botany at Cornell University, was born at Milwaukee, Wisconsin, U.S.A. His informative lectures on plant physiology have been particularly welcomed in recent years by Spanish men of science, notably at such centres as Madrid and Barcelona. His botanical studies comprise researches in fermentation, the organic nutrition of plants, germination of orchid seeds, and the diseases of the banana.

Prof. McMURRICH was educated at Upper Canada College, Toronto, at the University of the city, and at Johns Hopkins University, Baltimore. He has occupied posts in several universities of the United States, but since 1907 he has been professor of anatomy at Toronto. In 1922 Prof. McMurrich was president of the Royal Society of Canada.

Sir CYRIL KIRKPATRICK was educated at Repton. His engineering studies were conducted, in the first instance, at the Crystal Palace School of Engineering; afterwards he entered the service of the old London and North-Western Railway. Sir Cyril was chief engineer of the Port of London Authority from 1913 until 1924.

Prof. E. B. WILSON, distinguished as a zoologist, was born at Geneva, Illinois, U.S.A., and educated at Yale University, New Haven, and Johns Hopkins University, Baltimore. In 1883 he was a lecturer in biology at Williams College, fulfilling afterwards various important duties elsewhere until 1891, when he was appointed professor of zoology in Columbia University. Prof. Wilson is a foreign member of the Royal Society of London, and of the Linnean Society. In 1914 he delivered the Croonian lecture before the former body, taking as his subject "The Bearing of Cytological Research on Heredity." A member of the National Academy of Sciences, Washington, and of several English societies, he is Hon. Sc.D., Cambridge. Prof. Wilson is the author of a standard work, "The Cell in Development and Heredity"; originally issued in 1896, it passed recently into a third edition.

Prof. BRYCE was educated at Edinburgh Collegiate School. He graduated later at the University of Edinburgh. Lecturer on anatomy in the University of Glasgow from 1892 until 1909, he was then appointed to the chair of anatomy. The Royal Society of Edinburgh awarded Prof. Bryce its Keith prize in 1906 for his memoirs on the histology of the blood of the larva of *Lepidosiren paradoxa*. He is the author of vol. 1 of "Quain's Anatomy" and joint author of a work on the development of the human ovum.

Prof. HILTON, an old pupil of Lancing College, graduated at Hertford College, Oxford. Sometime assistant lecturer in mathematics in the University of Bangor, he afterwards joined the teaching staff of Bedford College. Since 1912 he has been professor of mathematics in the University of London. Prof. Hilton is the author of many papers in crystallography, especially the theory of crystalline structures.

Societies and Academies.

SYDNEY.

Linnean Society of New South Wales, July 28.—C. T. **White**: On a small collection of plants from the Rigo district, Papua. Two species, one of Plectronia and one Jasminum, are described as new.—C. P. **Alexander**: The Trichoceridæ (Diptera) of Australia. One genus and four species are described as new. A key is given for the determination of the genera.—R. H. **Cambage**: Notes on the native flora of New South Wales. Part xi. Moree to Mungindi and Moonie R., with a description of a new species of Eucalyptus. The paper contains notes on the early exploration, topography, etc., and a list of the plants noticed. A comparison of this flora is made with that of Tasmania, in view of the dominating influence of climate on plant distribution.—G. H. **Cunningham**: Gasteromycetes of Australasia. (v.) The genus Calvatia. The genus may be separated from Lycoperdon by the method of dehiscence, which is effected in Calvatia by the irregular falling away of the apical portion of the peridium; whereas in Lycoperdon dehiscence is effected by means of a definite apical stoma. The genus contains about eight species, of which four are present in Australia and New Zealand.—G. D. **Osborne**: Stratigraphical and structural geology of the Carboniferous rocks in the Mt. Mirannie and Mt. Dyrring districts, near Singleton, N.S.W. There are two volcanic series with associated clastic rocks, and separating these series is a set of sediments called the Main Clastic Zone. The major volcanic series comprises andesites, dacites, rhyolites and keratophyres, while the lavas in the other group are chiefly toscanitic and dellenitic. The only glacial beds occur near the top of the Kuttung Series, and Rhacopteris-bearing strata are found on two horizons. The chief tectonic feature is the great Bridgeman Fault which separates the Kuttung Series from the Permian or Permo-Carboniferous Series. This is probably an overthrust. In addition there are many normal faults connected with the late Palæozoic diastrophism which folded the area and produced two basin-structures.

WASHINGTON, D.C.

National Academy of Sciences (Proc. vol. 12, No. 8, August). R. J. **Havighurst**: The absorption of X-rays in crystalline compounds. The mass absorption coefficient in a compound is the sum of the mass absorption coefficients of the individual atoms and has been calculated from various empirical formulæ. Measurements upon crystalline compounds are subject to large experimental error on account of "selective absorption" due to reflection of the primary ray from certain atomic planes. Compressed slabs of powders (and also Wingardh's data from solutions) give results in good accord with the calculated absorptions for sodium chloride and fluoride and calcium fluoride and carbonate. Carl **Barus**: (1) Acoustic pressures in case of soap bubbles. A series of soap bubbles were attached to the telephonic apparatus and pinhole probe. Pressure as measured by the fringe displacement of the interferometer always corresponded with the radius of the bubble. (2) Acoustic pressure promoted by co-operating quill tubes without pinholes.—Edwin H. **Hall**: Note on the temperature relations of photo-electric emission and thermionic emission of electrons. Hall's theory of "associated" and "free" electrons in metallic conduction indicates a slight increase with temperature in the work done in detaching completely an associated electron; this accords with the fact that

the lowest frequency producing photo-electric emission is nearly independent of temperature. Also the work done in detaching completely a free electron within the metal should diminish with rise of temperature; this has not been disproved.—R. de L. **Kronig**: The dielectric constant of diatomic dipole-gases on the new quantum mechanics.—F. L. **Mohler**: A photo-ionisation experiment with hydrogen. Using a double thermionic tube, one unit of which produced a discharge while the other detected photo-ionisation excited by the radiation from the discharge, no evidence was obtained that hydrogen emits radiation which can ionise the normal molecule.—Otto **Laporte**: Series and ionisation potentials in the iron spectrum. —Carleton C. **Murdock**: The location of the electromotive force in a photo-active cell containing a fluorescent electrolyte. Semi-transparent platinum films sputtered on opposite sides of a glass test-tube serve as electrodes. The electrolyte can be illuminated before it reaches the electrode, through it, or after leaving it, and is made to flow along the surface of the electrode. The photo-active electromotive force is due, in part, to the action of light on the fluorescent electrolyte.—Richard C. **Tolman** and Sinclair **Smith**: Remarks on Professor Lewis's note on the path of light quanta in an interference field. —L. R. **Maxwell**: The mean free path of electrons in mercury vapour. An electron stream passes through a chamber the end of which is a long Faraday cage. The electron current was measured with and without the presence of mercury vapour at a pressure of 3·12 bars in the chamber. The distance traversed by the electrons was varied by raising and lowering the cage. The mean free path is calculated for accelerating potentials up to 3000 volts; at 1120 volts and 3050 volts it is 73 cm. and 144 cm. respectively.—Edward A. **Birge** and Chancey **Juday**: The organic content of lake water. Large samples from Wisconsin lakes were examined. The quantity of organic material present is much greater than, and that of the inorganic salts is far less than, that found in sea water. The dissolved organic matter forms a potential food supply several times as large as that offered by the plankton.—Thomas Wayland **Vaughan**: (1) The stratigraphic horizon of the beds containing *Lepidocyclina chaperi* on Haut Chagres, Panama. The horizon is upper Eocene, virtually the same as that of the Ocala limestone of Florida and Georgia. (2) Foraminifera from the upper Eocene deposits of the coast of Ecuador. The horizon is about the same as that at Haut Chagres; the finds indicate that the same fauna existed on both sides of America during Eocene times.—T. J. **Webb**: On the free energy of hydration of ions. The energy of hydration depends on the dielectric properties of the solvent, as well as upon the charge and effective radius of the ion.—Curt **Stern**: An effect of temperature and age on crossing-over in the first chromosome of *Drosophila melanogaster*. Susceptibility is connected in some way with the localisation of the spindle fibre attachment.

Official Publications Received.

BRITISH AND COLONIAL.

Aeronautical Research Committee: Reports and Memoranda. No. 989 (Ae. 200): An Investigation of the Flow of Air around an Aerofoil of Infinite Span. By L. W. Bryant and D. H. Williams; with an Appendix by G. I. Taylor. (A. 3. a. Aerofoils, General, 132.—T. 1885.) Pp. 44. 1s. 9d. net. No. 995: The Behaviour of Single Crystals of Aluminium under Static and Repeated Stresses, Parts 1, 2 and 3. By H. J. Gough, Dr. D. Hanson and S. J. Wright. Work performed for the Engineering Research Board of the Department of Scientific and Industrial Research. (B 1. a. Metals, 40, a and b.—T. 1983, a and b.) Pp. 54+35 plates. 8s. 6d. net. No. 1015 (Ae. 218): On the Drag of an Aerofoil for Two-dimensional Flow. By A. Fage and L. J. Jones. (A. 3. A. Aerofoils-General, 154.—T. 2135.) Pp. 14. 7d. net. (London: H.M. Stationery Office.)

Leicester Museum, Art Gallery and Library. Bulletin No. 10. Pp. 12. (Leicester.)

County Borough of Warrington: Museum Committee. Report of the Director for the Two Years ending 30th June 1926; with a List of the Principal Additions to the Museum Collections. Pp. 21. (Warrington.)

Transactions of the Royal Society of Edinburgh. Vol. 54, Part 3, No. 14: Magnetic Quality in Crystals. Part i: Discrimination of, and Stability in, Magnetic Lattices; Part ii: Stability of Magnetic Lattices; Part iii: Twinning in Crystals. By Dr. J. Forrest. Pp. 601-701. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 12s. 6d.

Union of South Africa: Department of Agriculture. Science Bulletin No. 45: Physiological Studies of the Grape. By Dr. Francois Jean de Villiers. Pp. 97. (Pretoria: Government Printing and Stationery Office.) 1s. 6d.

Northampton Polytechnic Institute, St. John Street, London, E.C.1. Announcements, Educational and Social, for the Session 1926–1927. Pp. 176. (London.)

Decennial Index of *The Analyst*: the Journal of the Society of Public Analysts and other Analytical Chemists. Vols. 41-50 (1916 1925). Compiled by M. B. Elliott. Pp. 353. (Cambridge: W. Heffer and Sons, Ltd.) Paper, 21s. net; cloth, 25s. net.

Transactions of the Royal Society of Edinburgh. Vol. 54, Part 3, No. 16: On the Development of the Cranial Muscles in Protopterus and Lepidosiren. By Prof. F. H. Edgeworth. Pp. 719-734+9 plates. 5s. 6d. Vol. 54, Part 3, No. 19: The Petrography of Jan Mayen. By Dr. G. W. Tyrrell. Pp. 747-765. 2s. 6d. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

The Journal of the Royal Anthropological Institute of Great Britain and Ireland. Vol. 56, 1926, January to June. Pp. 206+15 plates. (London.) 15s net.

Aeronautical Research Committee: Reports and Memoranda. No. 1029 (E. 20): Hydrogen as an Auxiliary Fuel for a Solid Injection Oil Engine. By G. F Mucklow. (I.C.E. 529.) Pp. 16+17 plates. 1s. net. No. 1032 (Ae. 224): Wind Tunnel Tests on a Wing covered with Monel Metal Gauze. By F. B. Bradfield. (A. 3. a Aerofoils-General, 162.—T. 2239.) Pp. 2+1 plate. 4d. net. (London: H.M. Stationery Office.)

Report by the Hon. W. G. A. Ormsby-Gore, M.P. (Parliamentary Under-Secretary of State for the Colonies), on his Visit to West Africa during the Year 1926. (Cmd. 2744.) Pp. 188. (London: H.M. Stationery Office.) 3s. 6d. net.

British Honduras. Annual Report of the Forest Trust for the Year ended 31st March 1926. Pp. 24. (Belize, British Honduras.)

FOREIGN.

Proceedings of the Imperial Academy. Vol. 2, No. 7, July. Pp. xxi-xxiii+299-359. (Ueno Park, Tokyo.)

Ministero dell' Aeronautica, Aviazione Civile e Traffico Aereo: Ufficio Presagi. Le condizioni meteorologiche dell' Umbria nel mese di Settembre. Pp. 12+3 tavole. (Roma.)

Agricultural Experiment Station: Michigan State College of Agriculture and Applied Science. Technical Bulletin No. 76: Concentration of Materials and Rates of Application in the Control of Apple Scab. By W. C. Dutton. Pp. 18. (East Lansing, Mich.)

Bulletin of the Experiment Station of the Hawaiian Sugar Planters' Association. Entomological Series, Bulletin No. 18: Contributions to our Knowledge of South American Fulgoroidea (Homoptera). Part i.: The Family Delphacidae. By F. Muir. Pp. iii+51. (Honolulu, Hawaii.)

Museums of the Brooklyn Institute of Arts and Sciences. Report upon the Condition and Progress of the Museums for the Year ending December 31, 1925. By William Henry Fox. Pp. 75+3 plates. (Brooklyn, N.Y.)

Department of the Interior: U.S. Geological Survey. Bulletin 768: Geology and Oil Resources of the Puente Hills Region, Southern California. By Walter A. English. With a Section on the Chemical Character of the Oil, by Paul W. Prutzman. Pp. x+110+14 plates. 40 cents. Bulletin 776: The Mesozoic Stratigraphy of Alaska. By George C. Martin. Pp. xii+493. 75 cents. Bulletin 785-B: Potash Investigations in 1924. By Walter B. Lang. (Contributions to Economic Geology, 1926, Part 1.) Pp. ii+29-43. 5 cents. Water Supply Paper 558: Preliminary Index to River Surveys made by the United States Geological Survey and other Agencies. By Benjamin E. Jones and Randolph O. Helland. Pp. iv+108+2 plates. Professional Paper 143: Paleontology and Stratigraphy of the Castle Hayne and Trent Marls in North Carolina. By Lewis Burnett Kellum. Pp. iii+56+11 plates. 30 cents. Professional Paper 145: Geology and Oil and Coal Resources of the Oregon Basin, Meeteetse, and Grass Creek Basin Quadrangles, Wyoming. By D. F. Hewett. Pp. ix+111+32 plates. 1 dollar. (Washington, D.C.: Government Printing Office.)

Publications of the United States Naval Observatory. Second Series, Volume 10. In 2 parts. Part 1: Observations made with the Prime Vertical Transit Instrument, 1893–1912, by George A. Hill; Part 2: Total Solar Eclipses of August 30, 1905, and June 8, 1918, with Aviators' Notes on the Total Solar Eclipse of September 10, 1923. Pp. A cccviii+A 882+9 plates+B 416+50 plates. (Washington, D.C.: Government Printing Office.)

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 63: An Account of Experiments carried out to Determine the Experimental Error of Field Trials with Cotton in Egypt. By M. A. Bailey and T. Trought. Pp. ii+29+23 plates. (Cairo: Government Publications Office.) 10 P.T.

Report of the Aeronautical Research Institute, Tokyo Imperial University. No. 18: Eye shaped end of Bar investigated by Photo-elastic Method. By Kango Takemura and Yahei Hosokawa. Pp. 127-143. 0.40 yen. No. 19: On the Distribution of Shearing Stresses in Beams of certain Cross-sections. By Tuneo Inokuty. Pp. 145-204. 1.05 yen. (Tōkyo.)

List D: Wavelength Spectrometers, Monochromators, and Specialised Spectroscopes. Pp. 21. List E: Spectrographs. Pp. 24. List L: Micrometers, etc. Pp. 5. Water Jacketed Tubes. Pp. 2. (London: Adam Hilger, Ltd.)

Diary of Societies.

SATURDAY, OCTOBER 16.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Associates and Students Section) (at Neville Hall, Newcastle-upon-Tyne), at 3.—P. F. Hope: Steam and Electric Locomotives for Colliery Purposes.

BRITISH PSYCHOLOGICAL SOCIETY (at University College), at 3.—W. J. Messer: Conative Control.—R. J. Bartlett: Does the Psychogalvanic Phenomenon indicate Emotion?

PHYSIOLOGICAL SOCIETY (in Department of Physiology, Guy's Hospital), at 4.—Demonstrations on A Substitute for Blood Fibrin in Work on Digestion, by W. M. Clifford; and Peculiar Substance in the Central Nervous System of Cats kept on Autoclaved Meat, by C. Da Fano.—A. E. Clark-Kennedy and T. Owen: The Effect of Variation of Oxygen Pressure on the Respiratory Exchange during Exercise.—T. Lewis and Y. Zotterman: Reactions of the Skin to Ultra-violet Light.—T. Lewis and I. M. Harmer: The Release of Vasodilator Bodies in Response to Mechanical Stimulation of the Skin (preliminary communication).—W. Cramer: The Transplantation of Spleen.—W. W. Payne and E. P. Poulton: The Law of the Intestines as applied to the Œsophagus.—V. de Burgh Daly: The Effect of a Negative Pressure on the Heart-Lung Preparation.—A. D. Macdonald and W. Schlapp: Adrenaline Vaso-dilation.—K. Furusawa and R. M. T. Kerridge: The Buffering Powers of Cardiac and Skeletal Muscles of the Cat.—A. Levin: Fatigue, Retention of Action Current, and Recovery, in Nerves of the Spider Crab.—R. S. Creed and Sybil Cooper: A Reflex in the Knee Extensors caused by Active Contraction of the Flexors.—J. de B. Daly and E. B. Verney: The Site of the Receptors engaged in the Reflex Regulation of the Heart Rate.—E. B. Verney: Some Quantitative Experiments on the Secretion of Pituitrin in Mammals.—E. D. Adrian: Action Currents in the Optic Nerve.—E. T. Coxybeare, M. Maizels and M. S. Pembrey: Influence of Anæsthesia on Metabolism.—M. Maizels and A. C. Hampson: The Effects of Variations in PH on the Volume of the Red Cells (preliminary communication).

MONDAY, OCTOBER 18.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 4.—Sir John Rose Bradford: Harveian Oration.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—C. E. Shattock: Demonstration of Surgical Conditions of Lymphatic Gland.

ROYAL SOCIETY OF MEDICINE (Social Evening), at 9.30.—Sir Arthur Keith: John Bull: a Study in Anthropology.

INSTITUTION OF THE RUBBER INDUSTRY (London Section) (at Engineers' Club, Coventry Street).—W. H. Harford: Advertising.

TUESDAY, OCTOBER 19.

ROYAL SOCIETY OF MEDICINE, at 5.30.

INSTITUTE OF TRANSPORT (at Institution of Electrical Engineers), at 5.30.—Capt. F. L. Barnard: Commercial Flying.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—The Secretary: Report on the Additions to the Society's Menagerie during the months of June, July, August, and September 1926.—Dr. P. A. Buxton: Exhibition of Apparatus for the Measurement of Radiant Heat in the Tropics.—Miss Joan B. Procter: Exhibition of a White Example of the English Grass-Snake.—Prof. J. S. Huxley: Studies in Heterogonic Growth: the Annual Increment of the Antlers of the Red Deer (*Cervus elaphus*).—Dr. J. Waterson: On the Crop Contents of certain Mallophaga (Insecta).—J. R. Norman: A Synopsis of the Rays of the Family Rhinobatidæ, with a Revision of the Genus Rhinobatus.—Prof. D. M. Fedotov: The Plan of Structure and Systematic Status of Ophiocista (Echinodermata).—Dr. R. Anthony and G. M. Iliescu: Étude sur les Cavités nasales des Carnassiers.

ROYAL PHOTOGRAPHIC SOCIETY (Scientific and Technical Group), at 7.—T. Thorne Baker: The Use of Light-Sensitive Cells in Photometry, Wireless Picture Telegraphy and Television.

WEDNESDAY, OCTOBER 20.

SOCIETY OF GLASS TECHNOLOGY (at Leeds University), at 2.30.—General Discussion on Annealing and Lehrs.—E. A. Coad-Pryor: The Economics of the Annealing Process.—Dr. J. W. French: Glass Annealing.—Dr. S. English and Prof. W. E. S. Turner: The Relationship between Chemical Composition and the Upper Critical Annealing Temperature of Glasses.

ELECTRICAL ASSOCIATION FOR WOMEN, at 3.—Visit to London Electric Wire Co., and Smith's Ltd., Leyton.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Dr. W. J. O'Donovan: The Prevention and Treatment of Eczematous Conditions of the Skin of Occupational Origin.

ROYAL SOCIETY OF MEDICINE (History of Medicine Section), at 5.—W. G. Spencer: Review of the 'Proceedings' of the Section.—Dr. Le Roy Crummer: The Anatomical Plates for the work of Geminus.

NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (at Iron and Steel Institute), at 5.30.—R. Jenkins: The Rise and Progress of Manufacturing Industry in England (Presidential Address).

INSTITUTION OF AUTOMOBILE ENGINEERS (Birmingham Graduates' Section) (at Chamber of Commerce, Birmingham), at 7.30.—W. Evans: Engine Lubrication.

SOCIETY OF CHEMICAL INDUSTRY (Nottingham Section) (at University College, Nottingham), at 7.30.—F. H. Carr: The Manufacture of Organic Medicinal Chemicals.

MERSEYSIDE AQUARIUM SOCIETY (at 1 Falkland Road, Egremont), at 7.30.—W. Mallinson and A. G. This: The Construction of a Simple Aquarium.

INSTITUTE OF CHEMISTRY (London Section), at 8.

C.B.C. SOCIETY FOR CONSTRUCTIVE BIRTH CONTROL AND RACIAL PROGRESS (at Essex Hall, Strand), at 8.—Dr. C. W. Saleeby: The Expectant Mother.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Prof. E. Ghosh: A New Classification of Ciliata.—Dr. J. E. McCartney: The Filterable Viruses.—B. K. Mullick: Notes on some Rotifers from India.—Dr. A. Piney: A Method of Silver Impregnation of Zenker-fixed Paraffin Sections.

ROYAL SOCIETY OF MEDICINE (Surgery Section), at 8.30.—W. Low: Surgery and the Workmen's Compensation Act (Presidential Address).

THURSDAY, OCTOBER 21.

CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Miss Margaret Morris: Dancing as Physical Culture.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Dr. W. H. Eccles: Inaugural Address.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30.—W. R. D. Jones: Notes on Magnesium and some of its Alloys.

CHEMICAL SOCIETY, at 8.—Prof. H. V. A. Briscoe, P. L. Robinson, and H. C. Smith: The Density of Boron Trichloride, and the Suspected Variation in the Atomic Weight of Boron.—W. H. J. Vernon: The Formation of Protective Oxide Films on Copper and Brass by Exposure to Air at Various Temperatures.—W. H. Gray: The Action of Antimony Trichloride upon some Diazotised Diamines.—E. H. Farmer and J. Ross: The Formation and Stability of Associated Alicyclic Systems. Part III. The Change from 'Meta-' to 'Para-' bridged Rings.

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE, at 8.15.—Prof. N. H. Fairley: Studies in the Chemotherapy and Immunity Reactions of Schistosomiasis.

ROYAL AERONAUTICAL SOCIETY (Coventry Branch) (at Coventry).—Major F. M. Green: The History of the Aeroplane.

FRIDAY, OCTOBER 22.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Demonstration of the Anatomy of the Sacro-iliac Region and its Application to Practice.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—W. Reavell: Presidential Address.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—R. H. Kenyon: Boiler Accidents.

INSTITUTE OF METALS (Sheffield Local Section) (at Sheffield University), at 7.30.—Prof. H. C. H. Carpenter: Sorby Lecture.

ROYAL SANITARY INSTITUTE (at Town Hall, Dover), at 7.30.—Discussions on Diphtheria Immunisation.

OIL AND COLOUR CHEMISTS' ASSOCIATION.

PUBLIC LECTURES.

SATURDAY, OCTOBER 16.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Mrs. H. M. Dunn: Kashmir, the Country and its People.

SUNDAY, OCTOBER 17.

GUILDHOUSE (Eccleston Square), at 3.30.—Air Vice-Marshal Sir Sefton Brancker: The Scientific Problems of Commercial Aviation.

TUESDAY, OCTOBER 19.

ROYAL SOCIETY OF MEDICINE, at 5.—Prof. Abel: The Development and Present State of Public Health in Germany (Chadwick Lecture).

SCHOOL OF ORIENTAL STUDIES (London Institution), at 5.—Dr. L. D. Barnett: An Introduction to Indian Philosophy. (Succeeding Lectures on November 2, 16, 30; December 7; January 18; February 1, 15; March 1 and 15.)

KING'S COLLEGE, at 5.30.—Prof. C. Lloyd Morgan: The Place of Mind in an Organic Theory of Nature. (Succeeding Lectures on October 26 and November 2.)

UNIVERSITY COLLEGE, at 5.30.—K. Lansma: The Drainage of the Zuyder Zee.

WEDNESDAY, OCTOBER 20.

INSTITUTION OF ELECTRICAL ENGINEERS, at 5.30.—Prof. J. A. Fleming: The Interaction of Pure Scientific Research and Electrical Engineering Practice. (Succeeding Lectures on October 22, 27, 29; November 10, 12, 17, and 19.)

ROYAL SOCIETY OF MEDICINE, at 8.—Prof. Abel: The Development and Present State of Public Health in Germany (Chadwick Lecture).

THURSDAY, OCTOBER 21.

FULHAM CENTRAL PUBLIC LIBRARY, at 8.—H. T. Davidge: The Earth we Live on.

SATURDAY, OCTOBER 23.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—V. Gordon Childe: The Dawn of Civilisation in Europe.

SUNDAY, OCTOBER 24.

GUILDHOUSE (Eccleston Square), at 3.30.—Prof. W. A. Bone: The Economic Aspects of Coal.

CONGRESSES.

OCTOBER 13 TO 26.

GERMAN SOCIETY FOR THE STUDY OF DISEASES OF DIGESTION AND METABOLISM (at Berlin).

OCTOBER 20 TO 22.

TEXTILE INSTITUTE (at Town Hall, Buxton).—Sir William Bragg (Mather Lecture).—J. A. Robertson: Centralised Electricity Production.—P. Bean: Sizing of Artificial Silk Yarns, and Comparison with Sizing of Cotton Yarns.

OCTOBER 21.

COKE OVEN MANAGERS' ASSOCIATION (at Midland Hotel, Manchester).—Annual General Meeting.

OCTOBER 25 TO 28.

ITALIAN CONGRESS OF SURGERY (at Padua).

SATURDAY, OCTOBER 23, 1926.

CONTENTS.

Science and Religion.

AT the recent Church Congress held at Southport, several papers dealt with the relations between science and religion. This is a subject of the deepest interest to students of natural science, for the ultimate objects of religious study and of scientific research are the same. This was finely expressed by no less a person than Sir Ray Lankester, whom no one will accuse of a bias in favour of theology, when he was president of the British Association at the York meeting in 1906. In his presidential address he claimed the sympathy of the Church for the scientific student, saying that the churchman and the student agreed in this: both had turned aside their gaze from the fleeting and temporal and had fixed it on the enduring and eternal; both, in a word, sought for the absolute and everlasting beneath the never-ending flux of things.

There are, it is true, many students of science, and especially of biology, who consider religion to be a name for a mass of outworn and discredited superstitions, and think that the best hope for the progress of mankind lies in getting rid of such beliefs entirely. This, however, is a view which biologists of wider outlook find it impossible to accept. For they recognise, on one hand, that the progressive evolution of man is bound up with the evolution of society, and, on the other, that every society is, and always has been, held together by religious sanctions, even when those sanctions are submerged in the subconscious stratum of our existence. Hence the conclusion is inevitable that religious belief performs an important biological function, and that it will endure so long as society itself endures. But religion can only exercise its proper influence so long as it is believed in sincerely; and hence the importance of reconciling, if possible, such beliefs with the scientific view of the universe.

The functions of religion and science are, in fact, correlative: one strives to hold fast and preserve the flashes of insight into the real nature of things which have been granted to mankind in the past; the other is ever seeking to gain new light on Nature. The reverence of religion for what is old is justified, because great discoveries of truth, or, as our fathers preferred to call them, 'revelations,' come but very rarely, and between them are interposed many generations of ordinary men to whom no new light is vouchsafed.

Every 'revelation,' however, is necessarily framed in a background of the current beliefs of its time about the universe; and as this background changes the 'revelation' comes to be expressed in obsolete language. The reconciliation consists in finding appropriate modern language in which to express it, and in the

search for this expression the modernist school of Anglican theology will have the sympathy of every student who reflects deeply on the ultimate mysteries which he encounters in his study of science.

Amongst the papers read at the congress, none excited more interest than that from the pen of the late Dr. Adami on "The Eternal Spirit in Nature." Many of our readers and contributors to our columns were friends of Dr. Adami, and sadly miss his bright cheery optimism and his infectious scientific enthusiasm. It will surprise many of them to learn that Dr. Adami, whose interests they had imagined to be confined to the technicalities of science, had reflected so deeply on the ultimate nature of things. His paper attempted the stupendous task of trying to prove from a consideration of scientific facts that there was one God Who was the author of the universe, that the nature of God was good, and was ultimately expressed in the character and teaching of the Founder of Christianity, and that the human soul was immortal. Dr. Adami's method was not that of the *a priori* philosopher: like all true scientific men he was a pragmatist, and he felt that these beliefs were justified, because when applied to the phenomena they yielded satisfactory results.

If, indeed, Dr. Adami had been successful in his attempt, then the complete reconciliation of science and religion would have been achieved: we fear, however, that we are unable to go the whole way with him. His argument for the existence of God is the presence of order and law in Nature: this order must have its ground in one grand unifying Will. Was it not Huxley himself who said that "Law, order, and abiding Force are more stupendous miracles than any to be found in our mythologies," and who ridiculed that heterodoxy which regarded the world as "a mud-pie made by two blind children, matter and force." The argument really comes to this: the human intellect, through the action of which alone religion, science, or any other kind of knowledge is possible, recognises amidst phenomena an order and regularity which it feels to be akin to its own deepest nature. Either that recognition is valid or it is illusory. If it is valid, then the ultimate nature of everything must be a Mind in some ways akin to the human mind. If it is illusory, then we are thrown back on a total agnosticism, and conclude that we learn from phenomena nothing of the real nature of things, and that our intellect, as Bergson has maintained, is only a tool-making and food-getting mechanism.

Although it is persistently ignored by shallow thinkers amongst 'practical' scientific men, there is a subjective element in all knowledge which cannot be neglected. We do not begin with 'matter,' which is an abstraction, but with 'something presented to my mind,' and the 'mind' to which it is presented is as fundamental as the 'something.' The qualities with which we endow matter are all mental, and can be expressed only in terms of perception, which is a mental function. Surely no one imagines that 'redness,' 'hardness,' and 'sweetness,' for example, exist outside of and independently of us. To describe the mind as the mere result of molecular movement is to commit an error beside which the wildest Irish bull must sound like common sense.

Dr. Adami's argument that God must be good is that the evolutionary process has led to the production of human nature, the highest aspect of which is goodness. This, again, is the old argument that the stream cannot rise higher than the fountain. "He that planted the ear, shall He not hear? Shall not the judge of all the earth do right?"

Against this argument, however, there are ranged the terrible facts of the struggle for existence and the slaughter of the unfit. If God be the author of Nature, how is this condition to be accounted for? If with Dr. Adami we reply that there is some end to be gained by this which we cannot understand, then the objector justly rejoins that every conscious-suffering individual is an end in itself, and has rights which it is wrong to sacrifice even for the well-being of another.

If, indeed, not only the human soul, but also the soul of all that suffers, survives bodily dissolution, then the ultimate satisfaction of the individual may be enhanced by suffering in some of the preliminary phases of existence. We fail completely, however, to see how Dr. Adami can prove the immortality of the soul from the facts of natural science; the utmost that can be said is that the vitalistic conception of biology leaves the possibility open. It seems to us that the essence of religious faith is the hope that God may turn out to be good, and the resolve to order our lives on this assumption. We hope, but we do not and cannot know. Dr. Adami's assertion that the highest expression of the nature of God is to be discovered in the Founder of Christianity leads us into the realm of special theology, which it is outside the province of this journal to discuss. This much, however, all will admit: that so far no finer conception of God has been presented to the human intellect than that embodied in the sayings of Christ and of some of His early followers. In the field of natural science, it may not be necessary to postulate God; but in religion, as in science, the workings of an evolutionary process are now recognised. It is through the acceptance of the idea of evolution in the spirit as well as in the body of man that the partition which formerly separated religion and science is being dissolved.

The Evolution of Voles and Lemmings.

Monograph of the Voles and Lemmings (Microtinæ), Living and Extinct. By Martin A. C. Hinton. Vol. 1. Pp. xvi + 488 + 15 plates. (London: British Museum (Natural History), 1926.) 30*s*.

THERE is no group of mammals so likely to throw light on the manner in which new species arise as the Microtinæ, a subfamily of rodents represented by voles and lemmings, and there is certainly no one so well qualified as Mr. Martin A. C. Hinton, of the Zoological Department of the British Museum (Natural History), to bring together and to systematise all that is known concerning the distribution in space and time, the structure and habit, of this highly specialised group. It may be said at once that Mr. Hinton is producing a monograph—for the volume noted here is only the first part—of the very highest order, one which will serve the needs of systematic zoologists for many years to come. In the present volume 14 genera, including 120 species, are defined and described, a score of the species having been discovered and named by the author. Great and abiding as is the service which Mr. Hinton is thus rendering to systematic zoologists, he is doing even more for the student of evolution, and it is to this aspect of his inquiries which we desire to direct attention now.

In the common water vole, Mr. Hinton finds that although sexual maturity is attained at a comparatively early age, yet growth never ceases; growth changes are continued so long as the individual lives, so that aged animals may have the appearance of being specifically distinct from younger adults. There is, in particular, a continual transformation of all those parts of the skull which are concerned in mastication. In the water vole there is a tendency for the growth discs of long bones to remain open. More remarkable still are the growth changes in the teeth. As is well known, the development of a tooth begins with the formation of a crown and ends with the production of a root. The incisor or gnawing teeth of rodents remain perpetually young; they never proceed to the formation of a root but go on producing crown as long as the animal lives. This retention of an infantile stage in the growth of incisor teeth took place at an early stage in the evolution of rodent mammals. In the course of time this tendency spread from the incisor to the cheek or molar teeth of rodents. Mr. Hinton has demonstrated that a tendency to a delay in the formation of roots and an inclination to continue the growth of crowns has appeared in the molar teeth of various members of the Microtinæ, and at different horizons of the geological record. The molar teeth of the water vole never cease growing. Mr. Hinton also emphasises the fact that in the production of new specific forms the whole apparatus of mastication and of digestion—teeth, jaws, skull, temporal and masseter muscles, great bowel and cæcum—undergo a simultaneous and co-ordinated hypertrophy.

Now, changes of an exactly similar kind to those which Mr. Hinton has noted in the evolutionary history of voles and their allies have come under the observation of medical men. In acromegaly—a disorder of growth which occasionally overtakes men and women—jaws, muscles of mastication, skull and skeleton, and the various parts of the alimentary canal undergo just such changes as those which occur normally in adult water voles. Such growth changes in the human body are always accompanied by a disordered enlargement and action of the anterior lobe of the pituitary gland. Medical men also meet with cases in which the growth lines of bones tend to remain open, and although they cannot identify the exact part of the growth mechanism which is at fault, yet the evidence already collected leaves no doubt that the defect lies in the hormone system which regulates growth. These growth changes, with which medical men are familiar, have nothing to do with 'use and wont,' but are disordered manifestations of a growth mechanism which is resident in all living tissues.

Nowhere does Mr. Hinton mention the name of Lamarck, yet from statements he makes it is clear he must be placed amongst the followers of that great naturalist.

> "Every mammal," he writes, "is the product of two distinct and sometimes conflicting forces; a compound of relatively essential characters, fixed for the time being in each group by inheritance, and of more or less plastic characters which yield like potter's clay to the thumb of stern necessity. It is the special use which an animal makes of its various organs that results eventually in a more or less perfect adaptation of form and structure to particular functions, no matter whether the special use is called into being by tempting opportunity or by the compelling stress of circumstances. Use and habit, and all that goes to make environment in its widest sense, have thus made species what they are." (p. 4.)

In this extract Mr. Hinton leaves his readers in no doubt as to the factors which he conceives as being the most important in bringing about the evolution of new species. We may take one of his remarkable examples of adaptation in order that we may probe more deeply into what his beliefs imply. In a Greenland lemming (Dicrostonyx) the fur becomes very thick as winter sets in and at the same time the claws

> "of the third and fourth manual digits become highly modified for digging and subject to a remarkable and unique seasonal change; with the approach of winter these two claws grow to an extraordinary size and

develop a peculiar supplementary ventral portion which sometimes surpasses the main part of the claw in length; but with the return of spring this ventral portion is shed and the main part of the claw is then worn down to normal length. The bones of the fore-arm, particularly the ulna, are greatly strengthened for the attachment of the powerful muscles which move the fossorial hand."

Now the utility of all these changes, which permit Dicrostonyx to burrow in a frost-bound soil, is very apparent, but how 'use and wont' can bring about such a series of growth changes is not at all clear. The more we come to know of the machinery of growth, the less likely does it seem that 'use and wont' can effect any direct change on structure; use and habit can bring out of the claws of the Greenland lemming just such growth responses as are already resident in them. If these responses are lacking, no matter how the lemming-burrows or how hard the soil may be, its efforts will only wear the claws away. Here again we may fall back on observations made in the human body. If a hundred young recruits are submitted to the same course of hard physical training, a certain number will respond readily and fully, their muscles taking on a quite Herculean contour: others scarcely respond to the trainer's efforts. Between these extremes all intermediate stages occur. The environment has been the same for all; the response has depended on the degree to which the muscles and bones, heart and lungs, of the recruits have been endowed with the machinery which underlies the processes of growth. What is true of men is likely to hold for lemmings and voles. Environment can select, but there is no evidence that it can produce new forms.

Especially valuable is the contribution which Mr. Hinton makes to our knowledge of the evolution of the cheek teeth of the various members of the Microtinæ, for it is the characters of these teeth which give a clue to the identification of fossil species and to the evolutionary lines of their descent. The splendid series of drawings of skulls, jaws, and teeth by Mr. Terzi, and figures of the chewing surfaces of the teeth made by Mr. Hinton, render the reader's task easy. In interpreting the nature of the dental changes, Mr. Hinton has been influenced by the teaching of the late Dr. Forsyth Major, but most of his inferences are based on a first-hand study of extensive series of molar teeth. As to the accuracy of the facts observed by Mr. Hinton in the cheek or molar teeth of voles, lemmings, and their allies, there cannot be any doubt, but whether or not his interpretation of these facts will hold good, one may legitimately doubt. Indeed, Mr. Hinton has anticipated such a criticism, for in a footnote to p. 34 he states: "As long ago as 1914 Winge and I were comparing our views on this subject and he told me that I had got everything upside down. No doubt others will be of the same opinion to-day."

Voles and lemmings have three molar teeth on each side of their jaws; the middle molar is sheltered, and, in the opinion of the majority of students of dental evolution, would be regarded, on the evidence produced by Mr. Hinton, as the most conservative and primitive of the three. Mr. Hinton is of an opposite opinion. What he has demonstrated is that the free ends of the dental series, the front end of the first molars and the hind end of the last molars, are the plastic points of the dental series. One cannot see how an appeal to a multi-tuberculate theory of dental origin can explain the remarkable additions which have been made at the terminal points of the molar series of voles; the anterior 'loop' of the first lower molars and the hinder ends of the last upper appear to have in them the germinal properties possessed by the terminal sprout of a growing tree. From time immemorial crowns of teeth have been fully formed before they come into use. It is difficult to see how the manner of chewing or the degree of force exerted in this act can have brought about the changes noted by Mr. Hinton in the evolution of the molars of the Microtinæ.

We have reserved for a final paragraph a mention of the important contributions which Mr. Hinton has made, and is making, to our knowledge of the recent geological history of Britain. For the past twenty-five years he has searched the later geological deposits of England for fossil traces of the less conspicuous and smaller mammals. In the late pliocene deposits of East Anglia he has identified 13 species belonging to 4 genera of Microtinæ, the genus Mimomys being the oldest and Microtus the most recent of the pliocene forms. The high terrace of the Thames valley is evidently of the same age as the later Cromerian deposits, for in it Mr. Hinton has identified three of the genera of Microtinæ found in the late pliocene deposits of East Anglia. In the deeper or older deposits of the middle terrace of the Thames valley, fossil remains of three microtine genera occur, two of them—Evotomys and Microtus—being continued from the Cromerian horizon, while one—the genus Arvicola, to which the modern water vole belongs—appears for the first time. Mr. Hinton regards this genus as having arisen by modification from the pliocene genus Mimomys. In the upper or later deposits of the middle terrace an altogether different microtine fauna is found—one associated with a cold climate. Two forms of lemming make their appearance, and three forms of vole belonging to the genus Microtus, one being the snow vole.

No doubt this change in fauna corresponds with the maximum phase of glaciation; nowhere else in the recent geological deposits of Britain does Mr. Hinton

find any sudden faunistic change—only in the later deposits of the middle terrace and of deposits of the same age, such as those found at Ightham in Kent, and in the deposits of caves in the centre and west of England. In the lowest or third terrace of the Thames valley the microtine fauna of the cold period is continued. Traces of the modern water vole appear for the first time in quite recent deposits, but it is clearly closely related to a late pleistocene vole, distinguished by Mr. Hinton as *Arvicola præceptor*, which in turn is closely related to the late pliocene genus—Mimomys. Already the water vole of Britain is showing signs of breaking up into several local varieties the first phase in the production of new species. Clearly Mr. Hinton is justified in regarding the Microtinæ as being in a state of evolutionary plasticity, and he has also demonstrated that the fossil remains of this inoffensive and unobtrusive group of mammals supply geologists with trustworthy data on which to assign recent deposits to their proper horizons in time. The Microtinæ in their evolutionary history serve as geological clocks. Beyond a doubt the Trustees of the British Museum were well advised when they undertook the publication of Mr. Hinton's monograph.

Modern Photometry.

Photometry. By John W. T. Walsh. Pp. xxvii + 505. (London: Constable and Co., Ltd., 1926.) 40s. net.

IN his delightful book "With Nature and a Camera" Mr. Richard Kearton wrote (a few years ago): "It is wonderful to think that within the confines of the British Isles, on the eve of the twentieth century, it is still possible to find a man sitting on Friday night in a rude semi-underground house lighted only by the primitive stone lamp of his fore fathers of prehistoric times." He was referring to the primitive customs of Borrera in the Outer Hebrides. It is only yesterday that *light* of any sort, however feeble, was a great achievement. Then come demands for *more light*, and for *enough light*. Finally, the request is for *enough light of the right quality* which, by its approach to the properties of daylight, will show objects not only in form but also in their true colours.

In our modern world these questions of illumination are of the highest importance, and the relative illumination necessary for various purposes has been studied, so that in building a factory, say, it will be equipped with lamps so arranged as to yield the necessary light in the right quantity. The factory owner does not, of course, purchase light directly; he must pay for energy delivered by gas or electricity. Nevertheless, the study of the most economical production and distribution of the light calls for the development of accurate methods of measuring light quantities.

The human eye is, fortunately, a very accommodating organ. It will function more or less satisfactorily over a wide range of brightnesses. Hence the question of high precision in photometry is not likely to be of very much concern to the ordinary user, who will not experience much effect from a four or five per cent. variation of illumination unless he is trying to work with nearly the minimum of light. The demand for precision comes rather from the requirements of industrial competition in lamp manufacture; in testing various lamps for efficiency and the effects of ageing; in the investigation of the various reflectors and screens. Precision spectro-photometry is, however, of considerable importance to the user who requires light of daylight quality, and also it is important from many scientific and industrial points of view.

Photometry is by no means a purely physical operation. Although the modern tendency appears to be towards the elimination of visual methods, this can only be done by a thorough study of human vision. After all, the sensation of light is a purely subjective phenomenon, and it is not to be confounded with the radiation capable of evoking it.

Mr. Walsh's latest work on photometry reflects the enormous growth of the subject during the last few decades. In his capacities of senior assistant in the Photometry Division of the National Physical Laboratory, and of general secretary of the International Commission on Illumination, he has had unequalled opportunity of becoming acquainted with all sides of the subject; his treatise is in many respects the most complete and thorough-going which is at present in existence. The chapters include discussions of all the usual principles of photometry in addition to historical notes, the eye and vision, heterochromatic photometry, colour, physical photometry, and stellar photometry. Each chapter is concluded by a large and complete bibliography furnishing references to many original papers and books dealing with the subjects under discussion. Without doubt it will be of the greatest value as a work of reference for those who have to carry out photometric operations. The text is concisely and clearly written; the reader may place confidence in its accuracy. In addition, the diagrams are numerous and well drawn.

An adequate criticism of the book is extremely difficult to give on short acquaintance. The scope is probably wide enough to cover all the interests of a photometric laboratory, but it seems also to make a bid for the interest of the physicist and astronomer. These will, however, find the treatment of photographic photometry somewhat disappointing and brief.

One of the problems of greatest interest in modern spectroscopy is the measurement of the relative intensities of the lines in line spectra, and a fuller discussion of the photographic methods would have been very acceptable. On the other hand, the book includes many paragraphs which are quite out of place; such as those giving a highly condensed version of the derivation of Maxwell's electromagnetic equations, the thermodynamic discussion of radiation laws, and so on. Nobody turns to a book on photometry for matters of this kind, especially when they are discussed with the aid of complex equations written in the ordinary lines of text, where they are hard enough to see, let alone to understand.

The reader must not object to change. Spectrum diagrams are all plotted to wave number; in some cases the wave-length diagrams are given as well. There are obvious advantages for some physical discussions in using the 'wave-number,' but for many of the present purposes the familiar 'wave-length' is entirely suitable and adequate; there seems no obvious reason for the change from the familiar to the less familiar.

This is not the place to discuss fully the vexed question of nomenclature. The reader will, of course, find the terminology adopted by the International Commission, but in the writer's view the British section made a great mistake in translating the French 'intensité' by the English 'intensity.' In scientific English the word 'intensity' always connotes something analogous to 'energy per unit area,' but we are now asked to exchange the easily understandable phrase 'candle power' (as applied to a source) for the words 'luminous intensity.' Another recent innovation is the term 'luminous flux,' to be substituted for the term 'light.' Surely it would have been better simply to be more careful and definite regarding the use of the word 'light' rather than to introduce terms which, in the judgment of the present writer, show small signs of being generally adopted by the English-speaking scientific world, whatever is the case amongst photometric workers. Time and experience must decide, but evolution is preferable to revolution, even in this connexion. Cannot our specialists be a little more Fabian?

We may speculate in conclusion that the author of such a text-book has at the present time a very difficult task. He has a vast accumulation of material, very heterogeneous in composition, and a necessarily limited personal experience. Although some things stand out as secure and stable, there are many methods and ideas which are ephemeral and unsound. One plan is to include all the information possible, and leave it to the reader to take his choice; another is to adopt a severely critical attitude and reject all that is apparently non-essential. Mr. Walsh has at the present time avoided both extremes, but it may be hoped that the whole subject will henceforth gain in coherence and simplicity, and that this may be reflected in books of the future. The present book will, we feel sure, contribute materially to the healthy development of photometric theory and practice.

L. C. M.

Philosophy of Emergence of New Qualities.

Life, Mind and Spirit: being the Second Course of the Gifford Lectures delivered in the University of St. Andrews in the year 1923 under the general title of "Emergent Evolution." By Prof. C. Lloyd Morgan. Pp. xix+316. (London: Williams and Norgate, Ltd., 1926.) 15s. net.

THIS is the second course of Gifford Lectures delivered by Prof. Lloyd Morgan, and continues the first volume published under the title of "Emergent Evolution." It should be read in conjunction with the earlier volume, otherwise there are parts of the argument which might be found difficult to follow. Indeed, even with this aid, it is, it must be confessed, by no means easy reading. But the difficulty arises, in the main, from the difficulty of the subject and the profundity of the thought; and those who will make the effort to master the argument will find themselves amply rewarded. They will be encouraged in this task by the appeal that the tone and style of the writing must make to all readers, for the book, as a whole, is marked to an impressive degree by the dignity and urbanity of ripened wisdom.

Both books deal with that question of the emergence of new qualities which is so much in the centre of philosophical discussion at the present time. There are significant differences in Prof. Lloyd Morgan's treatment of the subject from that with which we are familiar in other writers, such as Prof. Alexander. We may, to begin with, get the impression that Prof. Lloyd Morgan recognises many more cases of real emergence than most writers. Even within the inorganic world he finds several stages. There are distinctively new modes of action in the behaviour of the molecule as compared with that of the atom, and again in the crystal as compared with the molecule. The novelty that occurs on the emergence of life is no different in principle from these cases. Then within the living organism we have the emergence of cognitive and reflective reference—we must not say mind—and, finally, the emergence of the spiritual or religious attitude, which consists in the acknowledgment of the working of Divine Purpose in

the universe. The differences in detail of these different levels are worked out with all the wealth of knowledge and reflection that we expect of the author.

If we continue our comparison with other writers we find that, for Prof. Lloyd Morgan, if there are more emergents, they are less emergent. What emerges in general appears to be rather a new pattern of what is already there than any positively new entity. We see this when we consider what is said about the place of mind in the process. Prof. Lloyd Morgan will not allow that mind emerges at any point in the evolution of life. On the contrary, mind is there from the beginning. He maintains the doctrine of "the unrestricted concomitance of life and mind," and will only allow the emergence of new types of action of mind and new relations between the mental and physiological sides of the vital process. Mind, by which he implies more particularly the enjoyment, apparently the conscious enjoyment, of the activity of the organism, is there at the lowest stages of life. But it is not there as a separate entity, with a substantial existence of its own, coming in, as it were, from outside and introducing new forms of energy. That is the animistic or 'hormic' theory, to which Prof. Lloyd Morgan is most resolutely opposed. As against it, he maintains that mind and body are merely two aspects of the same process, "two stories," as he phrases it, about the same series of events. This, in its turn, throws some light on what happens in the passage from the inorganic to the organic. It must be confessed that on this point we should like a good deal more information about Prof. Lloyd Morgan's point of view. But it is at least clear that there is, for him, no new entity or new form of energy which emerges.

The novelty of Prof. Lloyd Morgan's theory of emergence is seen most clearly when we come to deal with his view of the object of the religious consciousness. For Prof. Alexander and his followers, Deity is a new quality that emerges beyond the human level. For Prof. Lloyd Morgan, Deity does not emerge—though human acknowledgment of it does but pervades the whole from beginning to end. Divine Purpose *is* "the rational order of the cosmos." There is no supernatural and transcendent Being who intervenes at certain times or stages. But there is a purpose which is present in all that happens in the universe, and is none other than the "rational order" of the whole. Similarly, there is no particular point at which a naturalistic or scientific account becomes inadequate. That is always one way of looking at the facts. But, equally, there is always the other way of looking at the facts, which we call spiritual, and when we reach this point of view we have reached religion. We cannot pursue further the subtle, but difficult, argument in which Prof. Lloyd Morgan attempts to explain the sense in which he ascribes objective reality to the object of religious worship. Nor can we discuss here the degree to which his point of view is susceptible of being brought into accord with the ordinary assumptions of the religious consciousness.

The significance of the whole book is very great. To the philosopher it will, perhaps, lie mainly in the tendency which it shows not to remain contented with the simple acceptance of emergence as a mere brute fact, but to try to explain what is involved in it. Some might think that the explaining of it here comes very near to explaining it away. At any rate the main purport of the argument appears to be to reconcile the acceptance of some form of emergence with the monistic doctrine of the substantial identity of all that is, in which Prof. Lloyd Morgan is such a convinced believer.

G. C FIELD.

Our Bookshelf

Reports of the Progress of Applied Chemistry. Issued by the Society of Chemical Industry. Vol. 10, 1925. Pp. 725. (London: Society of Chemical Industry, 1926.) n.p.

THE main impression conveyed by this compendious work is the enormous activity that is being displayed in applying chemistry and physics to the whole gamut of the arts and crafts. There may be signs here and there of radical advances, but, generally speaking, elaboration or *Ausarbeitung*, as the Germans say, seems to be the main feature of present-day work. The few who make a business of studying and card-indexing abstracts of technical literature may not require reports of this kind—for in the main they are little more than collated summaries of abstracts and patents—but the great majority of chemists who desire to keep abreast of the times will find them very valuable.

The present volume covers twenty-three of the somewhat arbitrary but necessary sections into which applied chemistry has been classified by the Society of Chemical Industry; reports on sanitation and water-purification and explosives are omitted, but the section on non-ferrous metals which was absent last year has been restored to its place in this year's volume. A considerable number of changes has been made in the authorship of sections, one of the most important being the collective contribution on paints, pigments, varnishes, and resins, by members of the Oil and Colour Chemists' Association. This innovation has much to commend it, and might usefully be extended to other sections of an omnibus character; but care must be taken that such contributions do not become inordinately long. The fact that every year sees an extension in bulk prompts the suggestion that it would be worth while to make the experiment of asking authors to deal more generally with their subjects: to lay aside their abstracts as they write, but refer to them for filling in gaps and necessary figures after writing. In this way, it is thought, the contributions would be more readable and savour more of original thought and treatment than of paraphrasing the abstract literature.

The book under review contains many contributions of high merit, and the general effect is undoubtedly good, though, as usual, there are minor points that evoke criticism. In altering the title of the first chapter by inserting the word 'General' before 'Plant and Machinery,' an attempt has been made to justify the inclusion in this section of information on beet-sugar and artificial silk production and on nitrogen-fixation, topics that are also treated in their appropriate chapters. If this report were labelled 'Chemical Engineering,' and the material of it were supplied by members of the Chemical Engineering Group, its value would be greatly improved, especially if line-diagrams were used to clarify, or obviate, verbal descriptions of plant. Unnecessary errors in spelling and hyphenation are less numerous than in previous reports, but the inclusion of such eccentricities as 'steam-line filter' (p. 12), 'electroultrafiltration' (p. 18), 'Pittsburg' for Pittsburgh (p. 14), and 'Haüsser' for Häusser (p. 189) show the need of better editorial supervision. The opinion (p. 87) that synthetic methyl alcohol "will solve the motor spirit from coal problem" appears to betray ignorance of the fact that methyl alcohol is a very poor motor-fuel; and the following statement (p. 59) bears witness to confusion of thought and style: "The decrease in the amount of tar now being distilled in the country may be gathered from the fact that the 1923 and 1924 quantities were approximately 326 and 353 million gallons respectively." In conclusion, we suggest that each volume should contain a list of the errors in its predecessor, and also the full titles of many, if not all, of the technical journals referred to in the text. How many chemists, for example, could decipher the abbreviations: S. & I. P., R., and J. Inf. Dis.?

Le magnétisme. Par Prof. Pierre Weiss et Gabriel Foex. (Collection Armand Colin: Section de physique, No. 71.) Pp. viii + 215. (Paris: Armand Colin, 1926.) 8·40 francs.

ALL who are interested in the important subject of magnetism must feel that they owe a debt of gratitude to the authors of this little book. They are both distinguished for the researches which they have carried out on the subject, and as their work shows, combine skill in exposition with the imaginative faculty which belongs to the successful investigator. In this volume they have aimed at putting the reader in touch with recent researches which for the most part are to be found only in the original memoirs. Consequently they have confined themselves to a rapid summary of the definitions and fundamental laws of magnetism, though even here the careful reader will find much to repay study. Questions, such as the experimental technique and industrial applications, which have been discussed in previous works, have been left on one side.

To present the results of research in a coherent form is no easy task when they cover such a wide domain, but the authors have been successful in a high degree, and have shown how the experiments are to be interpreted by means of thermodynamics, statistical mechanics, and the anisotropy of crystals. A study of the magnetic properties of matter leads inevitably to the problem of the constitution of the atom, and thus is related to the most fundamental questions of present-day physics. To a certain extent the phenomena of magnetism are in good agreement with the atomic models which are demanded by the facts of radioactivity and radiation, but there are still unsolved problems. The theory of quanta leads to an elementary magnetic moment which is almost exactly five times the magneton deduced by Weiss from the experimental results. As the volume under notice bears the date 1926, we might have expected some account of the recent work of Sommerfeld and others, which serves to throw some light on the discrepancy. The final chapter does, however, contain a description of the quantisation of orbits in three dimensions and the confirmatory experiments of Gerlach and Stern. Though most students of physics are able to read scientific works in French, an English translation, if accompanied by some additional matter, would probably be welcome.

Kalkfrage, Bodenreaktion und Pflanzenwachstum. Von O. Arrhenius. Pp. vii + 148. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1926.) 8 gold marks.

A LIST of those who have set forth their views on some aspect or other of the reaction between lime and soil would be an almost complete list of the world's soil chemists. It is not only—perhaps not chiefly—because of the economic importance of the liming of soils that so much scientific work and thought have been given to the matter. Economic considerations undoubtedly brought about the inception of the work (and still remain in some quarters the diplomatic excuse for its pursuit), but the enormous development of the work is in large measure the result of the sheer fascination of an elusive problem, which seems to be more complicated with each step taken towards its solution.

In his survey of the problem, Dr. Arrhenius gives a brief and somewhat critical review of the opinions held by soil chemists and ecologists on the relation between plant growth and soil acidity, and of the multiplicity of experimental methods which have been invoked in the study of the subject. We recognise the difficulty of giving an account of a subject with so many aspects, particularly when there is great divergence of opinion about the relative significance of those aspects, but it is not easy to understand the omission from the book of an account of the work of Hissink and of Gedroiz on the relation of exchangeable calcium in the soil to the liming problem. The conceptions which have arisen from this work are well known to be playing a prominent part both in the scientific study of the liming question and in the solution of economic problems of farming. It is to be hoped that in a future edition some account of this aspect of the work will be given and the appropriate additions made to the otherwise valuable and extensive bibliography.

A feature of the book is a concise account of the work—to which the author has himself made important contributions of the observed relation between the weight of crop and the hydrogen ion concentration of the soil. Not all soil chemists and ecologists are able to agree with Dr. Arrhenius about the significance of this work and the validity of the conclusions drawn therefrom, but this account will be valuable both to its exponents and its critics. N. M. COMBER.

Colloid Chemistry: Theoretical and Applied. By Selected International Contributors. Collected and edited by Jerome Alexander. Vol. 1: Theory and Methods. Pp. 974. (New York: The Chemical Catalog Co., Inc., 1926.) 14.50 dollars.

MR. ALEXANDER, with the aid of sixty contributors of a dozen different nationalities, has made a gallant attempt to produce a comprehensive treatise on colloid chemistry in English. His success may be measured by the mass of useful material which is here presented, though the arrangement does not always make it readily available. The more general papers, for example, Harkins on surface energy, Hardy on lubrication, Freundlich on adsorption, Gibbs on aerosols, and Hatschek on viscosity, are models which might with advantage have been followed by some of the less eminent authors. The detailed discussion of any particular piece of experimental work is only permissible in a book of this kind when some very general principle is thereby illustrated, and on these grounds some half-dozen of the papers here printed should be relegated to the ordinary journals; their inclusion tends to produce the atmosphere of a *Festschrift*. Again, the actual matter of some of the articles is already available elsewhere; for example, that of Millikan on measuring the electrons, and the unduly long account given by Von Weimarn of his theory of the colloidal state. It is to be hoped that in the two volumes to follow the editor will be less merciful, even though his contributors write without hope of reward.

The ingenuity with which this mosaic of essays covers the field of theory and method is remarkable, but it is curious to find that the fundamental process of dialysis receives only a casual mention in two places. Recent developments in the use of electrodialysis are also neglected. No pains have been spared to provide adequate bibliographies, diagrams, and indexes, and with some patience in use this volume will form a valuable addition to the shelves of the colloid chemist.

P. C. L. THORNE.

Pflanzen als Gesteinsbildner. Von Julius Pia. Pp. viii + 355. (Berlin: Gebrüder Borntraeger, 1926.) 10·50 gold marks.

THIS book, which is founded in part on lectures delivered at the University of Vienna, aims at providing a comprehensive treatise on plants as rock-builders. It is intended both for geologists and botanists, but the whole mode of treatment is botanical rather than geological. The account of the Bacteria and Algæ, with which the book opens, will be useful to many students, though the amount of botanical detail included seems scarcely relevant to the main purpose of the book. Indeed, before the Cormophyta are reached, the reader can scarcely fail to become aware of a certain lack of proportion in the scheme of the work; nearly half the volume is devoted to the Bacteria and Algæ, while about the same amount of space is deemed sufficient for the higher plants from Bryophyta to Angiosperms. Even within the latter section of the book, the space assigned to different topics seems to have been allotted with little regard to their relative importance. Less than a dozen pages, for example, are assigned to the Coal-measure flora, whereas more than forty are devoted to marsh and moorland plants of the present day, which are included on the strength of their function as peat-formers.

The book is lavishly illustrated, the figures being mostly taken from well-known sources, which are cited. It may seem ungrateful to quarrel with such a wealth of excellent drawings in a book which has, to a certain extent, a popular aim, but one cannot but regret the space consumed by figures of some fifty flowering plants of the present day. The student, whether of geology or botany, would willingly have dispensed with some of these pretty pictures in favour of fuller bibliographies, especially in connexion with the chapter dealing with coal and its origin.

The Psychology of Social Institutions. By Prof. C. H. Judd. Pp. ix + 346. (New York: The Macmillan Co., 1926.) 8*s.* 6*d.* net.

"THE purpose of this book is to concentrate attention on the fact that social influences are of the highest importance in determining the character of human thought and conduct." To instincts and other inborn traits the author attributes little importance. This point of view now meets with widespread approval, and it is not proposed to quarrel with it here. There can be little doubt that the older social psychology, founding itself upon observation of the individual, over-emphasised the rôle of the so-called instincts of gregariousness and acquisition and the like. Whatever may have been the case with regard to the origin of institutions in respect to the part played by instinct, there is no question but that the vast accumulation represented in our social heritage now predominates in determining social conduct in general. Prof. Judd's book is to be welcomed in that it provides for the student an examination of certain social institutions at some length, during the course of which this point of view is kept continuously to the fore. But it cannot be said that the book contributes anything definite towards the solution of the numerous problems connected with the whole subject. It may be replied that this was not its purpose, and if this is so, then it has certainly fulfilled its limited object in driving home this one important lesson.

A. M. C.-S.

British Birds. Written and Illustrated by Archibald Thorburn. New edition. In 4 vols. Vol. 3. Pp. x + 168 + 48 plates. (London: Longmans, Green and Co., Ltd., 1926.) 16*s.* net.

THE third of the four volumes of Mr. Thorburn's new book on "British Birds" has now appeared, and fully comes up to the standard of its predecessors. It contains a further series of coloured plates of high merit, although a few, such as that of the lapwing, are decidedly less happy than the majority. We are glad to see that the female plumage is portrayed in very many cases, as is certainly necessary with such birds as ducks and game-birds, two of the principal groups dealt with on this occasion. Both sexes of the ptarmigan are shown in each of their three seasonal plumages. We could wish, however, that the nestlings also had more often been included in the plates, as has here been so successfully done in the case of the ringed and golden plovers.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Early History of Gaseous Adsorption.

THE publication in a recent part of *Proc. Roy. Soc.* (A, Sept. 1) of excerpts from the memoir of 1863 by Dr. R. Angus Smith of Manchester, on "The Absorption of Gases by Charcoal—(i.)," by the initiative of Mr. S. Lenher, calls to mind Angus Smith's service in collecting, with the help of James Young of Kelly, the scattered scientific papers of his friend Thomas Graham, in 1876. No more attractive account of the history and philosophy of the atomic theory exists than the short introduction which he prefixed to that volume. Physical chemistry was then being born, and the relevant ideas about atoms and the aether were in the foreground.

The John Hunter whose paper (*Journ. Chem. Soc*, 1865) is referred to by Mr Lenher was, I doubt not, the assistant trained to this kind of work by Thomas Andrews at Belfast, who died young In Andrews' address to the Chemical Section of the British Association in 1871 ("Scientific Papers," ed. Tait and Crum Brown, p. 318), which was a survey of the main recent advances, he devotes a paragraph to the work of his assistant.

"Hunter has given a great extension to the earlier experiments of Saussure on the absorptive power of charcoal for gases. Cocoanut-charcoal, according to Hunter's experiments, exceeds all other varieties of wood-charcoal in absorptive power, taking up at ordinary pressures 170 volumes of ammonia and 69 of carbonic acid. Methylic alcohol is more largely absorbed than any other vapour from 90° to 127°: but at 159° the absorption of ordinary alcohol exceeds it. Cocoanut-charcoal absorbs forty-four times its volume of the vapour of water at 127°. The absorptive power is increased by pressure."

One recalls that the late Sir James Dewar, who presented to science the technique of charcoal absorption at low temperatures, spent his earlier years at Edinburgh, where the work of Andrews would be familiar through his friends Crum Brown and Tait.

JOSEPH LARMOR.

Cambridge, October 1

The Structure of the Continents.

IN his letter on this subject published in NATURE of September 25, Dr. Harold Jeffreys cautiously favours the possibility that "the basaltic layer below the granite may be in a glassy state, as Daly has suggested," and he goes on to add that the underlying layer may well be dunite The evidence in favour of this view is based on:

(*a*) Earthquake records which show that compressional waves are transmitted through the upper layer with a velocity of 5·6 km./sec., through the lower layer with a velocity of 7·8 km./sec.; and through an intermediate layer with a velocity (measurable in one case only) of 6·2 km./sec.

(*b*) The work of L. H. Adams and R. E. Gibson (*Proc. Nat. Acad Sci*, May 1926, p. 275), which gives the velocities calculated from the observed compressibilities and densities, at pressures corresponding to depths of about 30 km., as 6·45 km./sec. for tachylyte (basaltic glass) and 8·2 km./sec. for dunite (peridotite composed mainly of olivine). As these results refer to ordinary temperatures, those corresponding to the temperatures below the granitic crust would be a little less.

The possibility of a layer of basaltic glass between granite and dunite—both crystalline rocks—seems improbable on general grounds. If the basaltic layer be glassy, then one would expect the dunite also to be glassy, in which case the velocity of compressional waves would probably be less, instead of greater, than that within the lower layer of the continents. On the other hand, if the dunite be crystalline, then the basaltic layer should also be crystalline, particularly as its existence is referred to differentiation due to the crystallisation and sinking of olivine; for if olivine could crystallise it is difficult to imagine conditions which would inhibit the crystallisation of pyroxenes and felspars (or a high-pressure equivalent). But in this case the velocity of compressional waves would be 6·9 km./sec. or more. Evidently all that can be safely deduced from the evidence is that the basaltic layer is not mainly composed of gabbro.

There is, however, an alternative interpretation of the intermediate velocity recorded by Jeffreys which should not be overlooked. L. H. Adams and E. D. Williamson (*Journ. Franklin Inst.*, April 1923, p. 520) have calculated the corresponding velocities in syenite and granodiorite at 6·2 km./sec., and in diorite at 6·4 km./sec. If, therefore, the granite of the upper levels of the continents passes down into diorite, a reasonable explanation of the intermediate layer is forthcoming In a recent paper (*Geol. Mag.*, July 1926, p. 317) I presented chemical and petrological evidence supporting the hypothesis that the continents were originally of granodiorite composition, and that as a result of igneous processes, mainly in pre-Cambrian time, the upper levels have become more granitic, leaving a complementary differentiate of diorite in depth This hypothesis is in accordance with the great abundance of diorites and andesites in zones of later mountain folding, and with the absence of any widespread intrusions of post-Cambrian granites comparable in their regional extent with those that preceded them in pre Cambrian time

If the intermediate layer of Jeffreys be identified with diorite instead of with basaltic glass, then the basaltic layer should exist in the high-pressure crystalline facies of eclogite. Unfortunately, the compressibilities of garnets or eclogites at different pressures have not yet been determined, but it seems probable that the velocity of compressional waves in eclogite would not differ seriously from that in dunite. A layer of eclogite passing gradually down into dunite at some unknown depth would then satisfy the seismic, petrological, and isostatic evidence In view of the great importance of testing this interpretation in the most direct possible way, I have expressed to Dr. L. H. Adams and his colleagues my hope that they will add to their work on basaltic glass and dunite a similar investigation of the elastic properties of eclogite.

A further objection to the identification of the intermediate layer with basaltic material, whether glassy or otherwise, arises from its shallowness in the crust. If, as Jeffreys suggests, it extends from a depth of 10 or 15 km. to a depth of 20 or 30 km., then it is difficult to understand how it could ever be raised to the high temperatures implied by the great extrusions of plateau basalts which from time to time in geological history have overwhelmed enormous areas in different parts of the world. This difficulty is relieved by the conception of an eclogite layer extending downwards from a depth of 20 or 30 km. into a region where the temperature is higher and heat of radioactive origin can be accumulated.

ARTHUR HOLMES.

The University, Durham, September 25.

Science and Psychical Research.

As I shall be shortly leaving for New Zealand, perhaps a little space may be granted me to reply to a number of letters which have appeared in the recent issues of NATURE, from the pens of Sir Bryan Donkin, Mr. Campbell Swinton (3), and Mr. E. J. Dingwall.

Some of the confused thinking represented in these letters may perhaps be stopped if I explain the genesis of the original article which has provoked the discussion. The editor of NATURE asked me to write a review of Sir Arthur Conan Doyle's book *from a scientific viewpoint*, and I said I would try to do it. After reading through the two volumes very carefully, I concluded that there was nothing scientific about the book. I do not care for merely destructive criticism, as I think that a badly written book is its own worst condemnation. Also I am not yet so far removed from youthfulness as to have forgotten what I owe to the talented author, for giving us, long ago, "The White Company" and the adventures of the immortal Sherlock Holmes So I told the editor that I had decided not to undertake the task He then suggested to me that I should write an "essay review"; that is, using the book as a peg, I should hang upon it a dissertation on a cognate subject of scientific interest, namely, psychical research. I accepted this offer, and chose the subject which has started the present discussion. Apparently it sufficed for some minds to draw the conclusion that, because my essay was hung upon a spiritualistic peg, therefore psychical research is the same thing as spiritualism! No doubt, if I had written an essay review on the subject of evolution, hanging it upon a book on neo-Lamarckism, let us say, as a peg, the same type of mind would deduce that this indicated that evolution was the same thing as neo-Lamarckism!

That psychical research and spiritualism are not at all the same thing can be easily demonstrated, I think, if we take the cases of two famous exponents of psychical research already more or less discussed in these letters. I refer to Lodge and Richet Both are admittedly psychical researchers of the first rank. Lodge is also a spiritualist, having come to the conclusion that survival is proved from his interpretation of the facts of psychical research Richet, admitting the truth of the same set of facts, but interpreting them from a very different viewpoint, is still a kind of 'super-materialist,' absolutely and irrevocably opposed to the spiritistic hypothesis, which he holds is disproved by some of the very facts of psychical research! Could anything be plainer, then, than that psychical research and spiritualism are two entirely different things? What should we say of the mentality that confused biology with neo-Darwinism or with neo-Lamarckism? What are we to think of those who confuse a line of experimental research with one of the hypothetical conclusions which, in the opinion of only a portion of the researchers, arises out of it?

Let me now reply more particularly to Mr. Campbell Swinton, who has been a fair and, on the whole, courteous opponent, though sadly tempted at times, I fear, to let out and say what he really feels. Perhaps I may be ready to meet him half-way in his criticism that the medium is not absolutely comparable with the microscope or the chemical balance; I ought perhaps to have used a closer simile and likened the medium rather to the catalytic agent, the presence of which is essential to the production of the phenomena in certain types of chemical change. What I wanted to bring out, and what I still maintain, is that a genuine medium is not *actively* a participant in the experiments; the phenomena are produced *through some extended action of his subconscious mind*, but not by active volition on his part.

Mr. Campbell Swinton ought to know that a set of negative results in an experiment does not prove anything when confronted with even a single well-authenticated positive result from the same experiment. How many times have we, who have taught chemistry in schools, seen some of the most carefully prepared experiments fail to succeed, to the great delight of the assembled class? Yet, once the positive result is obtained, the acute mind of the boy knows at once that the negative results are cancelled, and one good demonstration is enough for him. It is only muddled thinking of the adult mind which persists in quoting a series of negative results as decisive.

As regards psychic photography, the decisive positive result, in my opinion, has never yet been obtained So, in this particular case, I entirely agree with Mr. Swinton that there is *a high probability* that there is nothing in it. Many psychical researchers think the same; but spiritualists, on the whole, believe the opposite The question could be settled once for all, to everybody's satisfaction, if one of the alleged photographic mediums would consent to experiment under absolute test conditions in which he would not be allowed to handle the plates or to have access to them at any stage of the proceedings But I venture to think that it will be a very long time before any such thing as this is likely to happen

I think it is rather hard that all my critics should waste so many words on trying to prove that I am a spiritualist and that spiritualism is a delusion. If any of them had come to the National Laboratory of Psychical Research last week they would have heard my address on this very subject, in which I took the stand that the spiritistic hypothesis does *not* fit in with all the known facts of the case, and pleaded for a more thorough and scientific study of the phenomena, with the view of finding a general theory "which should harmonise all the discoverable facts in the same way that Darwin's great theory of Evolution harmonised all the known facts of biology" Surely Mr. Swinton, at any rate, will concede that I have never diverged from that view in the whole of this long discussion?

I am sorry that Mr. Swinton departed a little from the high level of his debate in the last paragraph of his letter in NATURE of September 25. The words *suggestio falsi* sound, to my ears, somewhat offensive, especially as the idea behind them has been derived from the second-hand information of mischief-makers, and has not been verified by Mr. Swinton himself. There are more than six hundred firms, associations, and companies in the London Telephone Directory having names beginning with the word 'national'. I think I need say no more than that we can justly claim to be quite as national in our organisation and outlook as most of them But as an excuse for refusing my invitation the objection to the word is surely puerile. Why does not Mr Swinton say that he has never in his life been to a séance and never intends to go to one? I would have preferred this direct statement to the somewhat unkind and unworthy innuendo which he makes instead. But, in any event, Mr. Swinton stands self-confessed as an illustration of the type of scientific man about whom I wrote my article, namely, the man who presents "an unscientific attitude to the subject of psychical research." I claim that the letters written by him and my other correspondents fully prove my point.

Mr. Swinton's remarks in his last letter, published in NATURE of October 9, are entirely correct and in agreement with my own views, except for his last paragraph. I never classed Richet with Crookes and Lodge "as a spiritualist" but only as a psychical

researcher. To do so would be "most misleading" if I had been dealing with spiritualism, but I was not. The title of my essay was "Science and Psychical Research," not "Science and Spiritualism." My plea to men of science is for a more scientific attitude of mind *towards psychical research*, not towards spiritualism.

Sir Bryan Donkin has gratuitously given his own interpretation to the words "supernormal phenomena," thereby ruling out all those manifestations which I consider to be the key to the whole situation. I have more than once stated that I do not know the difference between trance and sleep. If Sir Bryan does, will he please tell us? If he does not, why does he take up an attitude which will forever prevent the problem being solved? If some of our leading medical men would spare a little time, even though they be, as I am, hard-worked to the very limit, we should soon know something about this mediumistic state. But I have seen excellent supernormal phenomena produced with the medium wide awake and absolutely controlled and immobilised in good light, so the question as to what trance may or may not be does not touch the essentials of my argument. Sir Bryan cannot have it both ways. If he is opposed to the scientific examination of the trance state, then he takes an unscientific attitude towards this phenomenon and is another of those to whom my article was addressed. But if he thinks it ought to be studied, then he should range himself on my side in this discussion.

Mr. Dingwall, I can surely claim, agrees with me, for he uses my very words in his last paragraph. He says, "There is a good case for the scientific study of what are called supernormal phenomena." That is exactly what I said too! But the rest of his letter shows clearly what he wanted to imply, namely, that Dr. Tillyard had not seen enough supernormal phenomena to enable him to judge rightly. I concede readily that I have not seen anything like so much as Mr. Dingwall; if he were logical, he would *a fortiori* exclude Mr. Swinton and most other men of science from this discussion, as they have not even seen as much as I have seen. Why pick me out and leave them in?

Mr. Dingwall asks, very pertinently, "Can Dr. Tillyard tell us of any single medium who can produce some simple raps, under conditions which render their normal reproduction impossible?" Yes, I can. Stella C. has repeatedly, both in my presence and in that of many others, produced such raps inside a close Pugh Table at a distance from herself. Mr. Dingwall will doubtless criticise this experiment, as he has done to me personally, on the ground that, as the box is closed, nobody could really see what was going on inside it. Yet, in his report on the Margery mediumship he says that he particularly requested that the phenomena should be done inside a closed box, and, when this request was refused, he regarded it as highly suspicious. In other words, Mr. Dingwall is always ready with an argument *against* any particular experiment, even though his objections mutually destroy one another.

I would like to assure Mr. Dingwall that it is not the number of séances that a man attends, but his capacity to draw definite conclusions, which really matters. Mr. Dingwall has attended hundreds, but he is still in a mental fog, just like the schoolboy whom we all know, who may be given an experiment to do many times over, but can never make a clear deduction from it. I am quite content with the eight séances which I have attended. In two of them, undoubted evidence of fraud was easily discoverable. In one other there was no analysable result. In the other five, with three different mediums, definite supernormal results followed under strict test conditions. In other words, I have obtained, *five times over*, a definite proof that supernormal phenomena do undoubtedly occur, and so I join the ranks of those who, like Lodge and Richet, are convinced of this fact. No amount of negative evidence can outweigh these positive results. Let me also assure Mr. Dingwall that I am not very likely to add largely to my psychic experiences, not being a hunter after sensations. I have seen Sir Ernest Rutherford's experiment on the bombardment of the atom demonstrated twice. It is enough. I accept the fact that the atom can be broken up, and no longer desire to go on attending lectures which keep on proving the same thing. I have seen supernormal phenomena in abundance produced at five controlled séances. It is also enough to convince me that they occur. What is the true explanation of them remains still to me at least a partial mystery; according as the evidence may unfold itself in the future, I may yet find myself with either Sir Oliver Lodge or Prof. Richet.

Finally, let me again plead for a more scientific attitude of mind on the part of men of science towards psychical research. Perhaps I may live to see it, if I succeed in attaining the allotted span.

R. J. TILLYARD.

REFERRING to the discussion on this subject in previous issues of NATURE, might one ask: Is there not confusion regarding the aims of science and of psychical research, which at present are fundamentally dissimilar? We know that the object of experimental science, as distinct from philosophy and mathematics, is to obtain control over the energies of Nature by learning the laws inherent in matter; that science has never set a limit to the varieties of matter; that, consistent with its purpose, it accepts facts as it finds them; and that its function, *qua* science, has never been to prove *a priori* conceptions. Some of us forget, however, that the elementary conditions essential for the pursuit of its object are not compatible with the objects and conditions of psychical research. By way of contrast a simple statement of scientific requirements might be made as follows:

1. The first two indispensable and interdependent factors in any scientific problem are the trained research worker and *something to be examined*. The thing to be examined may not have been contacted by all the physical senses, as, for example, electricity; but it must have been experienced by means of one sense-faculty, at least, before it will come to the attention of human beings or within the range of scientific research. (Scientific instruments are merely the extension of our physical senses.) It was not necessary to prove the existence of electricity; the problem was first, how to induce, and second, how to control or direct it.

2. It is essential for real scientific research that the matter investigated be, to some extent at least, under the control of the investigator, and this is possible only through his knowledge of the laws which describe the action of energy under certain specified conditions.

3. Science has advanced each step in its progress on the knowledge of laws already ascertained. Much was known concerning the chemical elements and conductive materials before electro-chemical phenomena could be investigated. Every factor in an experiment cannot be new.

4. Science requires for each advance a working hypothesis or theory about what is next to be discovered. The theory may be proved wrong, but nothing at all can be attempted in fresh fields without

a tentative supposition, a temporary theory which suggests a particular line of investigation, or some reason for doing one thing rather than another.

Now, the phenomena described as 'psychic' cannot come within the purvey of science if we accept the conditions given above. Men of science cannot examine something non-existent to them, and of which, consequently, no data exist, for there is then no basis for a beginning. It is impossible to undertake to 'test' that about which we know absolutely nothing. Thus a Gilbertian situation arises when it is proposed to examine 'psychic phenomena' scientifically: (1) The matter to be tested has as yet no existence; therefore (2) we know no laws by which its action could be induced; (3) we have no theory regarding its nature, laws, or cause; (4) we cannot control its production; (5) we do not know the nature of the medium through which it is proposed to attempt to induce the phenomena; and (6) the investigator cannot control or direct the energies which supposedly must operate to produce results.

Before science can enter this field there would have to be (1) an acknowledgment, derived from experience, of the reality of psychic phenomena, (2) the formulation of a scientific theory or working hypothesis of the possible laws inherent in the matter of the phenomena, and (3) some means found by which the experimenter could control the operations of the experiment. One does not by this preclude the possibility of prediction by mathematical science of the existence of a kind of matter hitherto unknown, a hypothetical state of organic matter, acting under electro-magnetic laws, analogous to inorganic states of invisible electro-chemical matter. Such a prediction could arise only from a more exact knowledge of physiological and psychological activities, but the first step in a true scientific investigation of 'psychic phenomena' cannot be taken until some deduction or other is attempted. It is necessary, therefore, for serious investigators of this phenomena, who affirm its existence, to state a case, to enunciate a working hypothesis not contradictory of the fundamental principles of exact science. The collection of instances and theories thereon, or hit-and-miss experiments in the vague expectation that something will be discovered, have never, and could never, in themselves, evolve a science. Terms used should be defined in such a way as to conform to the 'uniformity of Nature,' which is the one great deductive theorem of science. We know, however, that, although man is included in Nature in the largest sense of that term, science has as yet gained control only of energies latent in the mineral forms of existence and of *states preceding mineral precipitation*. The energies of the forms that *succeed*, *i.e.* of plants, animals, and man, have not been made subject to exact science. We have no practical knowledge of the laws that originate organic forms and govern their growth. Further, no man of science can alter the temperament or constitution of a human being, nor can he *isolate sensations, emotions, or thoughts from exterior influence and regulate them according to prescribed formulæ*. Hence, scientific attempts to isolate a 'medium' are childish. Equally puerile are 'tests' by measuring instruments. The *vacuum tube* preceded the measurements of the phenomena of modern physics. What is to be the vacuum tube for psychical investigation?

W. W. L.

How can the methods of scientific research be applied to the subject of the spirit world, which is of such post-vital interest to us all? To do so under existing conditions is generally impossible and always difficult. Faraday wrote to a friend: "I have been busy turning the tables on the table-turners." That statement was based on the results of definite experiments carried out under his own conditions.

In present circumstances, to follow Faraday's example and apply science to psychics is not easy. Would any manager of importance take his medium to the Royal Institution and submit without reserve to laboratory conditions?

Cannot the difficulty, if it does exist, be overcome by the use of scientifically trained mediums? Suppose, for example, prominent spiritists were engaged, in the first instance, to examine the staffs of colleges and scientific institutions throughout the country. It is probable that from such plentiful material a sufficient number of mediums of even moderate power could be obtained, when it is remembered that from one family alone a father, two daughters, and a son-in-law were all able to practise successfully as mediums. It would be desirable to exclude all who already have committed themselves intensely, those whose interest is mercenary, writers of imaginative articles for profit, those who seek prominence, and those imbued with the spirit of mischief.

Given the willing medium whose sole interest is science, and given suitable laboratory conditions, it should be possible to test the scientific basis of the claims of spiritists. It might even be possible to entice a ghost between crossed Nicols.

JAMES WEIR FRENCH.

Annesland, Glasgow, W.2,
October 6.

Transmission of Stimuli in Plants.

THE transmission of stimulation past a discontinuity has been demonstrated in Mimosa by Prof. Ricca and confirmed by Mr. Snow and others. On the other hand, Sir J. C. Bose has stated (NATURE, vol. 115, Jan. 10 and March 28, 1925, and also *Proc. R. S.*, Series B, **98**, p. 290) that he was unable to obtain this result.

I have for some time past been engaged in work on the transmission of stimulation in *Mimosa pudica*. Apart from my main line of work, and more as a matter of interest than from any doubt as to its validity, I have attempted to repeat this experiment. The method used was that described by Mr. Snow (*Proc. R. S.*, Series B, **96**, p. 349) in which the two parts of the shoot are connected together by a piece of water-filled rubber tubing.

The directions given by Mr. Snow were followed carefully, but for a long time I was not successful in obtaining the transport of the stimulus past the cut, although the experiment was repeated on a number of different occasions. The cause of the failures was finally found to be due to minute bubbles of air which emerged from the pith as the tension in the water increased. These bubbles collected in the space between the cut surfaces and interrupted the continuity of the water separating the two portions of the shoot. In Mr. Snow's experiments this effect does not seem to have been encountered, but possibly Sir J. C. Bose's failures are to be attributed to this cause. It may be of interest to describe a method which I have found successful in avoiding this difficulty.

A shoot was cut into two halves under water and the portions placed in a beaker of water in such a way that the two freshly cut surfaces were completely submerged. The beaker was then put into a large empty desiccator from which the air was exhausted by means of a vacuum pump. In this way air was removed from the intercellular spaces of the pith of the cut internode and, when air was readmitted to the desiccator, these spaces became injected with

water. The two portions of the shoot were removed and connected with water-filled rubber tubing in the usual way, the two cut surfaces being brought very close together. The whole shoot was then supported in air in a horizontal position, the basal end being immersed in water. After a resting period of two hours, to enable the shoot to recover its normal condition, it was stimulated by the application of a flame to a basal internode.

On the two occasions on which the experiment was tried, using the above-mentioned method, the stimulus affected, first of all, the leaves on the basal portion of the shoot, and then, after a pause of more than one minute, it traversed the water-gap and affected the leaves in the apical portion. For example, in one case, the two leaves in the basal part moved after 4 sec. and 8 sec. respectively, while beyond the discontinuity the times at which the leaves moved were 1 m. 16 s., 1 m. 49 s., 2 m. 21 s., and 2 m. 29 s.

If Sir J. C. Bose will repeat his experiments, using the precautions mentioned above, I am sure that he will be able to convince himself of the need of modifying his statements (NATURE, vol. 115, Jan. 10, 1925) "that the transpiration-current has nothing to do with the conduction of the excitatory impulse" and that "*the conduction is a phenomenon of propagation of protoplasmic excitation.*" There is no doubt that the stimulus can be carried across a discontinuity by means of the transpiration current, and that in this case, at any rate, the conduction has nothing to do with "the propagation of protoplasmic excitation."

It is somewhat surprising that Sir J. C. Bose (*Proc. R. S.*, Series B, **98**) should have failed to obtain stimulation by applying extracts of the stem to the basal end of a cut shoot. This result, which was obtained originally by Prof. Ricca and amply confirmed by others, strongly favours the hormone theory. Personally, I have not found the least difficulty in obtaining stimulation in this way.

NIGEL G. BALL.

University College, Colombo,
August 18.

Electric Television.

INVENTION appears to be multiplying in regard to this interesting subject, and I hear that more than one inventor in Paris is employing, for receiving, the cathode ray arrangement that I believe I was the first to publish in a letter to NATURE of June 18, 1908. The ideas embodied in this arrangement had occurred to me several years prior to that date, indeed not long after the production of the Braun cathode ray oscillograph invented in 1897. I actually tried some not very successful experiments in the matter of getting an electrical effect from the combined action of light and cathode rays incident upon a selenium-coated surface, in which I was assisted by the late Prof. G. M. Minchin, himself a great authority on electric cells sensitive to light, and also by Mr. J. C. M. Stanton. The transmitting apparatus consisted of a home-made Braun oscillograph in which a metal plate coated with selenium was substituted for the usual fluorescent screen, the image to be transmitted being thrown by a lens upon the selenium surface, and the end of the cathode ray beam being caused electromagnetically to traverse the projected image. Experiments were also tried in receiving with a Braun tube which I purchased in Germany, but in its then 'hard' form it proved very intractable.

My ideas in regard to this cathode ray arrangement for the production of television were further detailed and illustrated in an address I gave to the Röntgen Society on November 7, 1911, and still further elaborated and brought up-to-date, with wireless methods applied, in a paper I read before the Radio Society of Great Britain on March 26, 1924.

My idea, which was to use cathode rays as employed in the Braun oscillograph, instead of moving material parts, both in the transmitting and in the receiving instruments, is, as I understand, only at present being applied for receiving, mechanical apparatus being still used for transmitting. I desire, however, to point out that when the cathode ray is also applied to transmitting it will be possible to dispense entirely with all moving material parts, as the alternating or intermittent electric currents employed for moving the two cathode ray beams synchronously at the transmitting and receiving stations respectively can be supplied by oscillating thermionic valves supplied by batteries.

In this way it should prove possible to have electric television of a satisfactory fine-grain description without the employment of any mechanical motion of material parts whatever, as cathode rays are practically without weight and inertia, and can be deflected with perfect accuracy and synchronism at almost incredible speeds, while the accuracy of oscillating valves properly tuned is also wonderful.

A. A. CAMPBELL SWINTON.

October 9.

Active Nitrogen.

IN the "Research Items" in NATURE for September 18, reference is made to the paper by Willey and Rideal in the *Journal of the Chemical Society* for July, in which the energy of active nitrogen is found to be 42,500 cal. per gm. mol. Now Strutt's photographs of the glow produced when active nitrogen acts upon iodine show that the iodine line 2061 Å.U. is produced, and this needs an amount of energy of at least 150,000 cal. It is unlikely that a series of successive impacts could give to the iodine a higher level of energy than that possessed by the nitrogen, or that simultaneous collisions of the iodine with more than one nitrogen molecule would suffice. The nitrogen glow is destroyed by iodine vapour in an exceedingly small fraction of a second, which indicates the probability of exchange of energy taking place directly between the active nitrogen molecule (if it *is* the molecule and not the atom) and the molecule of iodine.

E. B. LUDLAM.
L. H. EASSON.

University of Edinburgh,
October 5.

Copper at Low Temperatures.

IN the August issue of the *Proceedings of the Royal Society* (A 112 [1926], pp. 136-151) a paper by Messrs. Lambert and Hartley on "An Investigation of the Effects of Variations in the Radiation Factor on the Efficiency of Dewar Vessels" records some interesting experiments which suggest that copper has unique radiating properties at about the temperature of liquid oxygen. In this connexion a peculiar phenomenon came to my notice some months ago, and it is possible that the two sets of observations may be related.

When present at a public lecture on 'Liquid Air,' delivered at the beginning of this year, I made the following observation during one of the lecture experiments. A small solid copper cylinder was immersed in liquid air contained in an unsilvered glass Dewar vessel in order to cool it down prior to its immersion in water to demonstrate the formation of ice. During the cooling of the cylinder in the liquid air, the usual rapid evolution of gas occurred on immersion, which lasted for some time, after which the liquid air became quiescent and it appeared that temperature

equilibrium had been reached. However, instead of remaining quiescent, as one would expect, after a few seconds a sudden re-evolution of gas took place, which was of short duration, and then a state of equilibrium was apparently attained.

I have recently confirmed this observation, and some experiments have been carried out to see whether this phenomenon is of general occurrence with metals, or whether it is specific for copper. It has only been possible, so far, to examine the following metals: lead, iron, tin, platinum and aluminium, and in these cases no such action was observed under similar conditions.

It appears from these experiments that either:

(1) Copper undergoes an allotropic change with heat evolution at a temperature slightly above that of liquid air. One is reminded of the phenomenon of recalescence in the case of iron at higher temperatures.

Or (2) a surface action peculiar to copper comes into play

Such an effect must cause a considerable loss in filling copper Dewar vessels with liquid air.

I have so far been unable to trace any record of this peculiar behaviour of copper in the literature.

GEORGE JAMES ALEXANDER.

Rock Ferry, Cheshire.

The Reaction to Flea Bites.

IT does not seem to be generally appreciated that the irritating wheals which may follow the bites of various insects are anaphylactic in origin. The first time that a person is bitten by a species of insect which has never bitten him before, nothing or next to nothing may happen, but when he has become sensitive to the proteid in the liquid which the insect injects in the process of biting, he develops the local irritable swelling which is familiar to most people.

Some years ago (*J. Path. Bact.*, **17** (1912), 110) I showed that my wife, who gave a violent reaction to the bite of the human flea (*Pulex irritans*), did not respond at all to bites of the rat flea (*Xenopsylla cheopis*) until they had been fed on her five times during six weeks, when she developed extensive wheals. We have recently got the same results with the rabbit flea (*Spilopsyllus cuniculi*). Single fleas were fed on June 6 and June 18, and four fleas on July 11, without any result; after feeding two on August 13 red papules developed seven days later; single fleas were fed on August 22 and September 1, and in each case a moderate reaction developed about 36 hours later. It is rather remarkable that the minute quantity of foreign proteid injected by the fleas in four bites should be enough to make a person sensitive. Lack of sensitisation is not, of course, the only reason why people do not react. Some persons who are extensively flea bitten seem to become immune. Others are naturally immune: however often I am bitten by them, I give no response to fleas of any kind, though midges and some mosquitoes irritate me extremely. At least that is so in Hertfordshire; from my only experience of Scotch midges, in which I was bitten very freely, I had no trouble, they were probably a different species.

The rabbit flea does not in my experience bite man very readily; in some trials I have quite failed to get them to do so even after several days' starvation. When they do, they take a long time to get their feed, and if undisturbed may remain attached for so long as an hour. Brumpt ("Précis de parasitologie," 3rd ed., 1922, p. 829) notices this peculiarity, which seems to apply to their feeding on rabbits as well as man.

A. E. BOYCOTT.

October 2.

Zoological Nomenclature: Hübner's (1806) 'Tentamen.'

THE secretary of the International Commission on Zoological Nomenclature has the honour to invite attention of the zoological profession to the fact that application has been made for the suspension of the International Rules, in the case of Hübner's (1806) 'Tentamen' in order to establish its nomenclatorial availability.

Briefly summarised: The formal nomenclatorial status of this document, involving about 100 names admitted by some authors as of generic rank, has been under controversy for many years, and opinion of specialists in Lepidoptera is still divided.

The arguments, as submitted, in favour of suspension of rules, maintain that: (1) there are sound reasons both for admitting and for denying recognition to the 'Tentamen' from the viewpoint of interpreting the Rules; (2) the evidence *pro* and *con* is not sufficiently conclusive to remove the question from debate; (3) the rejection of the 'Tentamen' will produce greater confusion than uniformity, will necessitate a vast amount of undesirable labour and economic loss of time and work; (4) if, on the ground of expediency, the rules can be suspended in this case, the nomenclature of the Lepidoptera, as used for the past thirty years, can be largely maintained.

The 'Tentamen' is one of the most important and most controversial cases ever submitted to the Commission. A discussion, with essential bibliographic references, will be found in *Smithsonian Misc. Coll.*, v. 73 (4) (now in press).

The Commission will delay announcement of vote, on the requested suspension, at least until September 1, 1927, in order to give interested authors, and especially entomological societies, opportunity to study the premises and to present to the Commission their views and arguments, *pro* or *con* regarding the action requested.

In order to protect groups other than Lepidoptera, a prerequisite to suspension of rules would be that representative specialists in Lepidoptera agree upon and furnish to the Commission definite bibliographic references to the 107 names which they view as genotypes.

C. W. STILES,
Secretary to Commission.

U.S. Hygienic Laboratory,
Washington, D.C.,
August 21.

The Problem of the Origin of Species as it appeared to Darwin in 1859 and as it appears to us To-day.

I HAVE discovered two errors in my recent paper which appeared under this title in NATURE of August 21, 1926. These errors were due to the hurried assemblage of facts and citations under the heading "Geographic Isolation and Speciation"; they will be carefully corrected in a sequel to this paper which is now in preparation for the *American Naturalist*, to be published under the title "The Origin of Species, V.: Speciation and Mutation." Meanwhile, I desire to point out as inaccurate the following statement in my paper:

"As an example of wide isolation without speciation, the house wren of Florida, *T. ædon ædon*, exhibits the same characters as those of Tierra del Fuego, but in the intermediate regions another species, *T. musculus*, exhibits a large amount of subspeciation and several complete intergradations."

On the contrary, the house wren is not known to breed in Florida and does not occur in Tierra del

Fuego. The species occurs in Patagonia and in the southern United States, but the birds from these two areas are specifically distinct.

The second erroneous statement is in the final paragraph of the same section, where (2) and (4) contradict each other:

"(2) . . . a desert subspecies, *P. m. sonoriensis*, reared for eight years in a humid environment, is entirely unmodified in the direction of the humid subspecies *P. m. gambeli*.

(4) Similar results from transplantation of *P. m. rubidus* and *P. m. sonoriensis* are obtained: reared in an entirely new environment, they do not converge toward each other but toward local humid subspecies *P. m. gambeli*."

Here (4) should read:

"Similar results from transplantation of *P. m. rubidus* and *P. m. sonoriensis* are obtained: reared in an entirely new environment, they do not converge toward each other or toward the local humid subspecies *P. m. gambeli*."

I regret having made these erroneous statements in a zoological field outside my own, and I trust that this correction will prevent their wider circulation.

HENRY FAIRFIELD OSBORN.

American Museum of Natural History,
September 21.

The Spectrum of Zinc.

IN the course of an investigation for the British Non-Ferrous Metals Research Association, which it is hoped will prove successful in applying the spectroscope to the quantitative assay of the impurities in zinc, the following observations of more special scientific interest were noted.

A zinc line, which does not appear to have been measured, occurs at λ2147·36 I. Å. (±0·02) near the cadmium line at λ2144·39 Å. Close to the 'raie ultime' of cadmium λ2265·04 Å is a zinc line the wavelength of which is λ2265·35 I. Å. (±0·02). This should be taken into account when searching the zinc spectrum for lines due to impurities, as with spectrographs of comparatively low dispersion, such as the Hilger quartz spectrograph size E. 31., the zinc and cadmium lines are indistinguishable. Hagenbach and Schumacher (*Z. wiss. Phot.*, **19**, p. 129, 1919) give the following as zinc lines: λλ2265·08 (8) and 2265·40 (2), and it is highly probable that the former line is a cadmium line.

Spectrograms were taken on a Hilger quartz spectrograph size E. 1. and the zinc lines measured on a photo-measuring micrometer size L. 1. using various samples of zinc.

The samples of zinc supplied by the British Non-Ferrous Metals Research Association included one sample from the New Jersey Zinc Co., prepared by fractional distillation after electrolytic refining, and was considered to be spectroscopically pure.

D. M. SMITH.

Research Department, Adam Hilger, Ltd.,
September 15.

Observed Relative Intensities of Stark Components in Hydrogen.

ATTRACTED by the singularly large observed variations (*Astrophys. Jour.*, **62**, 229, 1925) from estimated intensities of certain strong Stark components of H_β (H. A. Kramers, Copenhagen, 1919) we have recently made quantitative measurements from a suitable source by means of a neutral wedge. It is interesting to compare the results with the new theoretical calculations by Schrödinger (*Ann. d. Phys.*, **80**, 437, 1926). Following are the observed, calculated, and estimated ratios of intensities of components having polarisations and displacements as indicated. The displacement Δ is expressed in the unit which appears in the quantum theory of the Stark-effect.

Components Compared.	Ratio of Intensities		
	Obs.	Calc.	Est.
p components of H_β, $\frac{\Delta = +8}{\Delta = +10}$	1·00	1·06	0·40
s components of H_β, $\frac{\Delta = +4}{\Delta = +6}$	1·59	1·55	0·54

The much weaker components, p, $\Delta = +6$ and s, $\Delta = +2$ appear somewhat stronger than the theory indicates. This is possibly due in part to superimposed secondary spectrum lines, which could not be detected by the present method. Owing to the increased interest in this research, the measurements are now being extended to the weaker components and to H_γ and H_δ with such modification in method as to permit the detection of any seconday spectrum lines.

J. STUART FOSTER.
M. LAURA CHALK.
(National Research Student.)

McGill University, Montreal,
September 6.

Absorption Spectrum of the Hydrogen Molecule.

WITH the continuous spectrum described by Lyman (*Astrophysical Jour.*, **60**, 1) as a background, and with hydrogen flowing through the receiver of the spectrograph, it was found possible to photograph the absorption spectrum of molecular hydrogen in the extreme ultra violet. More than twenty absorption bands were observed between λλ1245 and 840. Most of the bands were clearly resolved and show the characteristic structure of the emission bands in the ultra-violet. The most striking feature of the spectrum is a progression of strong absorption bands beginning with λ1105. At least twelve bands of this progression were easily recognised. This adds a new electronic level to the three already obtained (Dieke and Hopfield, Oakland Meeting of the American Physical Society, June 1926) from the hydrogen emission spectrum. A continuous absorption spectrum begins sharply at λ840. This continuous absorption corresponds to the dissociation of the molecule into a normal and an excited atom. The long wave-length limit of the continuous absorption compares well with the theoretical value 14·4 volts. Complete details will be published later.

J. J. HOPFIELD.
G. H. DIEKE.

University of California,
Berkeley, August 17.

Sterility in the Vegetable Marrow.

THE vegetable marrow appears to have been affected by a form of sterility this season. I have been told of cases both in Gloucestershire and Surrey where the plants have produced an enormous number of male flowers and only one, or possibly two, female flowers. In the case of one marrow to a plant the resulting fruit has been a large one. Every plant was affected in the same way. No disbudding had been practised. In my own case I have had, as usual, an abundant crop, including about three dozen well-ripened fruits for winter use. The season has been favourable for half-hardy plants. Can any reader suggest a reason for this occurrence in a monœcious plant?

ELEONORA ARMITAGE.

Dadnor, Herefordshire,
September 25.

The Analysis of Line Spectra.[1]

By Prof. A. FOWLER, F.R.S.

RATHER more than sixty years ago, when the spectroscope became an effective instrument of scientific research through the work of Kirchhoff and Bunsen, it was regarded essentially as providing a new and powerful method of chemical analysis. It soon had brilliant results to show in the discovery of a number of new elements, but this kind of discovery could not go on indefinitely, and the interest of chemists as a body in spectrum analysis would appear to have declined rather rapidly. Spectrum analysis, as was soon realised, was not so simple a matter as it first appeared, and called for so much study that its pursuit was mainly left in the hands of a small band of specialists.

Some of the most important developments of spectroscopy have been closely associated with attempts to interpret the spectra of celestial bodies. The introduction of photographic methods by Huggins led almost at once to the discovery of new lines apparently belonging to hydrogen in the spectra of Sirius and other white stars, which were afterwards of great value in the establishment of Balmer's law of the hydrogen spectrum. Perhaps the greatest contribution of early astrophysics to our stock of knowledge, however, was that which so clearly pointed to the essential identity of matter throughout the universe.

With the discovery that the spectra of certain elements were modified by varying the character of the exciting source, chemical analysis of the sun and stars was supplemented and eventually overshadowed by investigations of the physical conditions which prevail in those bodies. The sun and stars thus came to be regarded as natural experiments on generally similar masses of matter at various high temperatures—experiments ready prepared for observation and always in operation. Thus many laboratory researches were directly instigated by astrophysical observations. To take one example, the fragmentary observations by Lockyer and by Liveing and Dewar of what were afterwards called *enhanced lines* were extended and systematised through an attempt by Lockyer, in which I myself took part, to interpret the spectrum of the solar chromosphere as photographed during the total eclipses of the sun in 1893 and 1896. The immediate result was an important correlation of the changes in the laboratory spectra of the elements with the succession of types in stellar spectra,[2] from which it appeared that enhanced lines were especially characteristic of stars which, on other grounds, were believed to be hotter than the sun. These investigations laid the foundations for a true interpretation of the spectra of the hotter stars, and led to the more extended studies of enhanced lines which have proved of such great importance in the development of the theory of the origin of spectra and the structure of atoms.

The remarkable developments of spectroscopy in the direction of atomic physics have resulted from discoveries relating to regularities in spectra. In the representation of series spectra the wave-number of a line always appears as the difference of two *terms*, and a series of lines appears as a regular succession of differences between a limiting term and a sequence of terms, the limit itself being a term of another sequence.

Much of the early work on series regularities in spectra is summarised in the now well-known symbolic representation of a series system, namely:

Principal series . . .	$1\,S - mP_i$
Sharp series	$1\,P_i - mS$
Diffuse series . . .	$1\,P_i - mD_i$
Fundamental series . .	$2\,D_i - mF_i$

where 1 S, for example, represents an individual term, and mS a sequence of terms of S type. The S terms are always single, but the others are complex in all but singlet systems; so that $i=1$ for singlets; 1, 2 for doublets; and 1, 2, 3 for triplets (in the older numeration). A sequence of terms may be represented by an approximate formula such as that of Hicks, in the form $R/[m+\mu+\alpha/m]^2$, where R is the Rydberg constant, m a serial number, and μ and α constants (usually proper fractions) to be determined from the observed lines. The possible combinations of terms in the production of lines are restricted in accordance with selection rules which have since been extended to more complex spectra, as will appear later.

It should be understood that these studies of the structure of spectra were pursued with the clear conviction that they would ultimately reveal the secrets of atomic structure, and the analysis of spectra, as distinct from spectrum analysis, gradually became one of the principal objects of spectroscopic research.

With the advent of Bohr's theory of spectra in 1913, spectroscopy entered on a new phase of activity. The theory and its immediate explanation of the spectra of hydrogen and ionised helium are now so well known as to call for little more than mention. Adopting the Rutherford conception of a neutral atom, spectroscopic terms were translated by the theory into 'energy levels' of the atom, so that a spectrum line is considered to represent the energy emitted by an excited atom when it passes from a non-radiating state of a certain energy to another of lesser energy. The terms are, in fact, proportional to the energies of the corresponding 'stationary' states.

The theory in its first form also gave a definite significance to the enhanced lines occurring in the spectra of other elements besides helium, and predicted that such lines would form series systems for which the series constant would be 4 R, 9 R, 16 R, and so on for atoms at successive stages of ionisation.

Bohr's theory proved a great stimulus to experimental spectroscopy as well as to theoretical investigations. Among the first fruits was the experimental verification of the predicted 4 R value for the series constant in the spectra of ionised magnesium, calcium, and strontium.[3] Next, Sommerfeld's well-known extension of the theory of the hydrogen spectrum by taking account of the relativistic variation of the mass

[1] From the presidential address delivered to Section A (Mathematical and Physical Science) of the British Association at Oxford, on August 9.

[2] Lockyer, *Roy. Soc. Proc.*, vol. 60, p. 475 (1897).

[3] A. Fowler, *Phil. Trans.*, A, vol. 214, p. 225 (1914).

The verification of 9 R for doubly-ionised aluminium by Paschen (*Ann. d. Phys.*, vol. 71, p. 142, 1923), and of 16 R for trebly-ionised silicon by A. Fowler (*Roy. Soc. Proc.*, A, vol. 103, p. 413, 1923), followed in due course.

of the electron with its orbital velocity predicted a fine structure of the lines of hydrogen and of ionised helium which was almost immediately verified by Paschen's remarkable observations of the structure of ionised helium lines under very high resolving power.

A general explanation of the existence of several types of series S, P, D . . . in the spectra of more complex atoms immediately followed, namely, that such types of series are to be attributed to the action on the series electron of a perturbing field due to the presence of other electrons in the atom, producing a precessional motion similar to that associated with the relativity effect, but of very much greater value.

Apart from the first two groups and the aluminium sub-group of the periodic table, the spectra of the elements, with few exceptions, are extremely complex and long defied analysis. It was not until 1922 that a key to the structure of complex spectra was furnished by the investigations of Catalán, who was then working at the Imperial College of Science. The essential feature of Catalán's work was the discovery that in the arc and spark spectra of manganese, and in the arc spectrum of chromium, there were terms of greater complexity than the triple terms which had previously been recognised. It was this discovery that opened a way to the analysis of complex spectra in general. It has been pursued with amazing success by Catalán himself, Walters, Laporte, Meggers, Sommer, and others, and the main features of the structure of many spectra as complicated as that of iron have been revealed.

It is not necessary to go into all the intricate details of the spectra, because the general results can now be very simply summarised in consequence of the theoretical developments which have gone hand in hand with the experimental investigations. Bohr and Sommerfeld had already established certain 'selection rules' for the combination of the terms of the simpler spectra on a quantum number basis, and immediately following the work of Catalán, Sommerfeld showed that the scheme of 'inner quantum numbers' which he had devised for the simpler spectra could be extended so as to fit the observations empirically. As other spectra came to be disentangled, an assignment of quantum numbers which appears to be adapted to all spectra was completed by Landé.

In accordance with the work of Bohr, Sommerfeld and Landé, a spectral term may be represented by four quantum numbers, written in the form n^r_{kj}. Here n is the *principal* quantum number, increasing by unity for successive terms of the same sequence; k is the *azimuthal* quantum number and has the values 1, 2, 3, 4, 5 . . . . . . for the term types S, P, D, F, G . . . .; j is the *inner* quantum number, having one or more values according as the term is single or multiple; r represents the *maximum multiplicity* of terms in the system to which the term belongs, so that $r=1$ for singlets, 2 for doublets, 3 for triplets, and so on.

The selection rules regulating the term combinations of most general occurrence are:

For different types of terms: $\Delta k = \pm 1$.

For individual component terms: $\Delta j = \pm 1$ or 0, with $j=0$ to $j=0$ forbidden.

For systems of terms: $\Delta r = \pm 2$ or 0.

Apparent exceptions to the first selection rule, $\Delta k = \pm 1$, are of very frequent occurrence. In the spectra of the alkaline earths there are several groups of lines—some of them of great intensity—which do not belong to the regular series, but are related to them through the characteristic separations of the respective triplet systems, as was first recognised by Rydberg more than thirty years ago. Groups of this type were further investigated by Popow and by Götze, and their real structure was deduced from observations of Zeeman effects. It then appeared that such a group was derived from combinations of P terms of the regular series with another set of P terms, or of ordinary D terms with a second set of D terms. The additional types of terms, which are usually distinguished as 'anomalous terms' and designated by P', D' . . ., have the same inner quantum numbers and show the same Zeeman effects as ordinary terms of corresponding types; but in their combinations with the regular terms they mostly follow the rule $\Delta k = 0$, giving the combinations PP', DD' . . . . Among themselves, however, the anomalous terms combine in accordance with the ordinary selection rule, $\Delta k = \pm 1$, giving such combinations as P'D', D'F' . . . . Such terms are not restricted to the spectra of the alkaline earths, but have been found to be of very general occurrence in all but the simplest spectra.

In the actual analysis of a spectrum, the selection rules which have been indicated for the combination of terms are supplemented in a very practical way by Sommerfeld's 'intensity rule' and to a less degree by Landé's 'interval rule.'

The whole question of intensities in related groups of lines has recently been placed on a quantitative basis through photometric measurements initiated by Ornstein, Burger, and Dorgelo at Utrecht. It results that the intensities in such groups are in the ratio of integers, and it may accordingly be concluded that intensities, like frequencies, are determined by quantum considerations.

Unfortunately, the analysis of a spectrum does not always lead to a knowledge of the actual values of the terms, or energy levels. These can be determined for any of the relatively simple spectra, in which comparatively extended series can be traced and their limits calculated. In most of the complex spectra, only the relative values of the terms have been deduced, since extended sequences in these spectra are apparently of rare occurrence. Even for these, however, the term of highest numerical value, representing the lowest energy level, can often be identified, and this is of special value in view of its association with the normal state of the atom.

This completes the story of spectroscopic terms and their possible combinations on what might be called a purely numerical basis; that is, in so far as the analysis of a spectrum can at present be based merely on a table of wave-lengths and intensities. Especially as regards the more complex spectra, however, advantage has to be taken of every possible experimental aid to the classification of the lines—particularly, in the first instance, as a means of sorting out the lines characteristic of an element at different stages of ionisation.

Thanks to the industry of numerous workers, many

of the complex spectra have now been partially analysed, and two of the principal generalisations foreshadowed some years ago have been greatly strengthened. The first of these is expressed by the so-called 'alternation law,' according to which the arc spectra of the elements are alternately of even and odd multiplicities in passing from the first to the higher groups of the periodic table. No exceptions to the rule have yet been found.

The second generalisation is expressed by the spectroscopic 'displacement law,' which states that the first spark (enhanced) spectrum of an element has a structure similar to that of the arc spectrum of the element which precedes it in the periodic table. To make this generally applicable, however, it is necessary to qualify the rule by restricting the meaning of similarity to a common odd or even multiplicity.

These rules have by no means been proved for all elements, but they are true for all spectra which have been disentangled up to the present time, and may safely be adopted as a starting-point in the analysis of further spectra. They have been almost completely verified for the elements of the two short periods Li (3) to Cl (17), but may be more effectively illustrated by the arc spectra of the elements K (19) to Ni (28) by the use of data collected by Catalán, which are given in Table I. The table includes references to the 'ground term,' *i.e.* the highest term or deepest energy level:

TABLE I.

TERM SYSTEMS IN ARC SPECTRA, K-NI.

Group	I	II	III	IV	V	VI	VII	VIII		
Element.	19 K	20 Ca	21.Sc	22.Ti	23 V	24.Cr	25.Mn	26 Fe	27 Co	28 Ni
Multiplicities	2	1, 3	2, 4	1, 3, 5	2, 4, 6	3, 5, 7	4, 6, 8	3, 5, 7	2, 4, 6	1, 3, 5
Ground term	^2S	^1S	^2D	^3F	^4F	^7S	^6S	^5D	^4F	^3F

A very striking relation, to which attention appears to have first been directed by Hund, is that, as regards the ground term, the spark spectrum of each of the elements Ca to Ni is more closely related to its own arc spectrum than to the arc spectrum of the preceding element. This may be shown as follows:

	20.Ca	21.Sc	22.Ti	23 V	24 Cr	25.Mn	26.Fe	27.Co	28.Ni
Arc . .	^1S	^2D	^3F	^4F	^7S	^6S	^5D	^4F	^3F
Spark . .	^2S	^3D	^4F	^5F	^6S	^7S	^6D	(^3F)	(^2F)

It is not improbable that such systematic relations will be of considerable assistance in the unravelling of the numerous complicated spectra which remain to be investigated.

The more recent results of the analysis of complex spectra have provided an ordered knowledge of a multitude of facts which have an important bearing upon the development of the theory of spectra and the arrangement of electrons in the outer parts of normal atoms. Theoretical workers have not been slow to utilise the new data, and have, indeed, frequently been able to forge ahead of experimental results.

The principal problems immediately resulting from the analysis of the more complex spectra resolve themselves into two—first, the distribution of the electrons among the various possible types of orbit; and, second, the deduction of spectroscopic terms from a given distribution of electrons.

In the consideration of the first problem we are not confined to the evidence afforded by optical spectra. Other data towards this end are furnished by X-ray spectra and by the variations of the chemical and physical properties of the elements according to their positions in the periodic classification. Bohr's well-known table of electron orbits (1922) was built up by taking account of these properties and considering the formation of atoms by the successive capture and binding of electrons. The orbits themselves were distinguished by the quantum numbers n_k ($k \leq n$), and it was assumed that the orbits of the earlier bound electrons were essentially unchanged when another electron was introduced into the system.

These ideas of Bohr have been remarkably developed in recent years, especially through the work of Main Smith[4] and Stoner,[5] who independently arrived at similar conclusions, chiefly from the consideration of chemical and physical properties respectively. In the new scheme the inner sub-levels are completed at an earlier stage than in Bohr's arrangement, and there is a greater concentration of electrons in the outer sub-levels of each group. The nature of the modification will be sufficiently indicated by comparing the electron distribution among the sub-levels in helium, neon, argon, and krypton, according to the old and new arrangements (Table II.).

TABLE II.

ARRANGEMENT OF ELECTRONS IN RARE GASES.

Bohr.

	Atomic Number.	K 1_1	L 2_1	2_2	M 3_1	3_2	3_3	N 4_1	4_2	4_3	4_4
He	2	2									
Ne	10	2	4	4							
A	18	2	4	4	4	4					
Kr	36	2	4	4	6	6	6	4	4		

Main Smith and Stoner.

	Atomic Number.	K 1_{11}	L 2_{11}	2_{21}	2_{22}	M 3_{11}	3_{21}	3_{22}	3_{32}	3_{33}	N 4_{11}	4_{21}	4_{22}
He	2	2											
Ne	10	2	2	2	4								
A	18	2	2	2	4	2	2	4					
Kr	36	2	2	2	4	2	2	4	4	6	2	2	4
	n_k	1_1	2_1	$\underbrace{\quad}_{2_2}$		3_1	$\underbrace{\quad}_{3_2}$		$\underbrace{\quad}_{3_3}$		4_1	$\underbrace{\quad}_{4_2}$	

The new scheme of electron distribution was shown by Stoner to be supported by a consideration of the intensities of X-ray lines, the absorption of X-rays, chemical and magnetic properties, and optical spectra. It retains all the essential features of Bohr's picture of the building up of atoms, and is equally in accord with chemical considerations, as is especially shown by the work of Main Smith. The electronic arrangements of all the elements from 1 to 92, in their normal states, may now be specified with considerable confidence.

[4] "Chemistry and Atomic Structure," London, 1924; *Review of Chemistry and Industry*, March 28, 1924.
[5] *Phil. Mag.*, vol. 47, p. 719 (1924); vol. 49, p. 1289 (1925).

With the attainment of a definite conception of the electronic structure of the various atoms it becomes possible to approach the second of the two problems referred to above, namely, the determination of the spectroscopic terms associated with a given distribution of electron orbits. The first steps were taken by Russell and Saunders, and independently in part by Wentzel, who, in a discussion of the so-called 'anomalous' terms, which have already been mentioned, made one of the most illuminating contributions to spectroscopy of recent years. To the three $^3PP'$ groups of calcium already known two more were added by Russell and Saunders, who were thus able to show that the five groups formed a series which could be approximately represented by a Ritz formula. The surprising result then appeared that, as referred to the regular triplet limits, the later P' terms were numerically negative. The earlier P' terms, having positive values, certainly originated in the neutral atom, and it could scarcely be doubted that the later terms also had the same origin.

The existence of these negative terms implies a greater equivalent energy than that required for ionisation of the atom, and it follows that it is possible for the atom to remain neutral while absorbing more energy than that necessary to remove the series electron. Hence, in accordance with a previous suggestion made by Bohr, but unknown to them, Russell and Saunders concluded that the energy must be divided between two (or more) electrons, each of which is displaced to a higher energy level, without the removal of either of them. The detailed numerical evidence led inevitably to the conclusion that both valence electrons might jump at the same time from outer to inner orbits, and that the net loss of energy would then be radiated as a single quantum, *i.e.* as monochromatic emission.

Arising out of the work of Russell and Saunders, together with further contributions by Pauli, Goudsmit, and Heisenberg, a general theory of complex spectra has been developed in a practical form by Hund.[6] The theory enables the deeper spectrum terms corresponding to any specified configuration of electrons to be determined with considerable certainty.

It is a fundamental feature of the new theory that, in a complex spectrum, the quantum numbers which specify an electron orbit are quite distinct from those which specify a spectroscopic term. The former are five in number, namely, n, k_1, k_2, m_1, m_2. The latter, which number three, are represented by r, l, j. The theory consists of semi-empirical rules for deducing r, l, and j for the deeper lying terms from the quantum numbers of the electrons in uncompleted groups.

The assignment of five quantum numbers to each electron orbit is due to Pauli, who supplemented it by a hypothesis—generally known as Pauli's principle—which asserts that no two electrons in an atom can occupy orbits having the same values for these five quantities. This principle can be shown to lead immediately to the scheme of electron distribution suggested by Main Smith and Stoner.

The extraordinary theoretical developments in recent years, leading to the prediction of certain features of the spectra of elements and the structure of atoms, have possibly overshadowed the progress in experimental spectroscopy. Nevertheless, much experimental work of immediate importance to theory has been carried on, and much more is urgently called for.

The present resources of experimental spectroscopy would appear to be adequate for the elucidation of the majority of the outstanding problems. For most elements the conditions of excitation can be so modified that the spectrum is well under control, so that all the lines, or only a selection of them, can be produced at will.

The old, well-tried methods of exciting substances to luminosity—the flame, arc, spark, and vacuum tubes—have by no means been superseded. They have, however, been supplemented by numerous other experimental arrangements. Some of these, like the electric furnace so effectively employed at Mount Wilson by A. S. King, have brought the spectrum of an element under more gradual control, so that a valuable aid in the classification of the lines of a complicated spectrum is provided by the order of their appearance as the temperature is raised. Other methods have definitely brought additional spectra within the range of laboratory experience.

One class of 'experiments,' as I have previously mentioned, is provided by the heavenly bodies. Saha's theory of high-temperature ionisation, further developed by Fowler and Milne and by Miss C. H. Payne, has already been utilised in the prediction of the ionisation potentials of certain multiply-ionised atoms for which the structures of the corresponding laboratory spectra have not yet been sufficiently determined to indicate the energies of the normal states. In this way it is conceivable that we may obtain approximate values of the actual energy levels in some of the complex atoms for which only relative values can at present be directly determined from the spectra.

Enough has been said, I hope, to give some idea of the main lines of development and present trend of spectroscopy. The analysis of spectra with which I have been chiefly concerned is a fascinating pursuit, and the establishment of a beautiful order out of an apparent chaos of spectrum lines brings great satisfaction to the investigator. I have endeavoured to show, however, that the analysis of spectra is not an end in itself, but that under the guidance of quantum theory it has fundamental contributions to make to our understanding of atomic structure and of the periodic classification of the chemical elements. It appears not at all improbable that some of the mysteries of chemical valency may also find a solution in the classification of spectrum lines, and there are indications that the conceptions of spectroscopy may ultimately extend our knowledge of the structure of matter in the liquid and solid states.

It may be that in the future the theory of spectra will be so far developed that it will become possible to calculate the positions and intensities of the lines composing the spectrum of an element with greater accuracy than they can be observed. We are, however, still very far from this ideal, and meanwhile experiment and theory must go hand in hand towards a better understanding of the problems that lie immediately before us.

[6] *Zeit. f. Phys.*, vol. 33, p. 345; vol. 34, p. 296 (1925).

Scientific and Industrial Research in Australia and New Zealand.

AT the Imperial Conference now in session, among other important problems for discussion is that of Imperial co-operation in scientific research. By far the most promising schemes for advancement in that direction, in Australia and New Zealand respectively, are those recently evolved by Sir Frank Heath, Secretary to the Department of Scientific and Industrial Research, London, as the result of his recent visit to those countries, at the invitation of their Governments, which have now unanimously adopted the proposals he has laid before them.

In addition to internal development, the importance of the protection of new countries against the accidental introduction of insect pests alone, not to mention plant pests, has lately been emphasised by Dr. Edward M. Ehrhorn, the well-known entomologist of Honolulu. He has stated that the losses caused by insect attack on the principal crops of the United States amount to upwards of 1,000,000,000 dollars a year, "a sum more than sufficient to meet the entire cost of the Federal Government's annual expenditures." Most of these pests were accidentally introduced, and many could have been excluded by a scientifically controlled quarantine.

Already in Australia rust and other fungoid diseases have attacked the wheat, but their ravages have been greatly lessened by the breeding of rust-resisting varieties, as initiated by Farrer of New South Wales, and by the disinfecting of the seed wheat with copper compounds. Formerly the seed wheat was dipped, before being sown, in a weak solution of copper sulphate. This poisoned the fungoid spores and so saved much loss from rust, but it somewhat damaged the seed wheat. Now, in lieu of this the seed wheat is dusted with finely powdered copper carbonate, and this process alone, as compared with the earlier one, is increasing the value of the Commonwealth wheat yield by about 2,200,000*l*. per annum.

This discovery, of vast value to Australia, the United States, and other wheat-growing countries, has been the result of 'team work,' partly by native-born Australian workers, partly by men trained in the best schools of the homeland, and the whole improved by American investigators. If the increased value of the American and other wheat crops throughout the world, accruing from this discovery, be added to the 2,200,000*l*. a year gained by Australia, the total sum realised would repay, many times over, all cost of agricultural research. A far greater gain will follow when, as the result of scientific breeding of wheat, both rust-resisting and drought-resisting types, are evolved. In view of such research, particularly in Australia, Prof. J. D. Watt, of the University of Sydney, considers the desired end is already in sight. What is true of scientific team-work applied to wheat, is true also of all the primary and secondary industries.

The key-note of the Australian and New Zealand research schemes is 'team-work': team-work within Australia and New Zealand themselves, and team-work within the Empire, but such team-work, to attain the best, must not be spasmodic. In Sir Frank Heath's words: "What the industries want is a steady long-sighted policy of help and advice from the State in a national movement for the co-operative attack on scientific problems similar to that successfully initiated here [New Zealand] in the marketing of products overseas." Again, the report on the Australian proposals refers to the distribution of the Commonwealth's activities among the States according to their suitability for different sections of the work as "a means of convincing them that the national effort in scientific things is a pervasive instead of a centralised and bureaucratic influence."

In order to give effect to the proposals of the Commonwealth Government for the reorganisation of the Institute of Science and Industry, an Act was passed by the Commonwealth Legislature in June last which provides as follows:

A Commonwealth Council of Scientific and Industrial Research to be constituted, consisting of not less than nine members, three nominated by the Prime Minister, and appointed by the Governor-General, and including the official chairman of the council. This body is to be the executive during the six-monthly interval between the meetings of the full council. The remaining six members of the council come from the six States of the Commonwealth, each of these members being the chairman, for the time being, of the State Committee (advisory to the Council of Scientific and Industrial Research) in the particular State to which he belongs. In addition, the council may co-opt such other members as may be approved by the Minister on account of their special scientific knowledge. In order to give continuity to the policy of the council, the scheme provides that each of the three executive officers shall hold office for several years.

The Act provides for the State Committees to be constituted "as prescribed." Under the Government scheme, the chairmen are to be selected by the Commonwealth Government after consultation with the State authorities: three members appointed by the State Governments from the staffs of their scientific departments; three members representative of pure science, of which at least two must be from the local universities —such men to be selected by the National Research Council; these six members and the chairmen to co-opt three (or, exceptionally, more) other members representative of primary and secondary industries within the State.

The Commonwealth Council has already held several meetings, and consists of the following:

Executive	G. A. Julius, *Chairman*, President last year of the Institute of Engineers in Australia.
	Prof. A. C. D. Rivett, Professor of Chemistry, University of Melbourne.
	W. J. Newbigin, Managing Director of the firm of W. J. Adams & Co., Ltd., an engineer and member of the Chamber of Commerce.

The remaining members are:

Queensland. Prof. H. C. Richards (Geology).
New South Wales. Prof. J. D. Watt (Agriculture).
Victoria. Sir David Orme Masson (Chemistry).
Tasmania. Mr. Keam (Pastoralist).
S. Australia. Prof. T. Brailsford Robertson (Physiology).
W. Australia. Mr. Perry (Industrialist).

In addition, the following two members have been co-opted:

Queensland. Prof. E. J. Goddard (Biology).
Melbourne. Prof. H. A. Woodruff (Veterinary Science).

Thus, both the Commonwealth Council and the State Committees are widely representative. Great freedom of action is given to the council by placing it immediately under the Prime Minister, not as one of his departments, but as an advisory council to him.

Annual estimates for the special work of the year have to receive the sanction of the Commonwealth Parliament in the usual manner, but the financial provision, of far-reaching importance, adopted by the Parliament is as follows: The appropriation from the consolidated revenue fund of the sum of 250,000*l.* to form a trust account, the capital and interest to be used for the purpose of scientific and industrial investigations. A further sum of 100,000*l.* has been appropriated out of the consolidated revenue fund as an endowment fund (of which the executive of the council are trustees), the interest on which is to be used: (1) to assist persons in their scientific research; and (2) to train students for scientific research. The Commonwealth Parliament also voted 29,000*l.* to clear off all debts left by the old Institute of Science and Industry. In addition, the sum of 50,000*l.* was asked for by the council for the particular work to be undertaken within the present financial year.

At the instance of the Prime Minister, the Right Hon. S. M. Bruce, the Cabinet gave immediate effect to Sir Frank Heath's recommendations for facilitating the further training in the homeland of the most promising young Australian scientific workers by sending four such, at once, to be trained for two years in research institutions, chiefly those attached to the Department of Scientific and Industrial Research, London. Four additional students are about to be nominated for training abroad. An allowance of 150*l.* is made to these students for their passages to and from Australia, and the salary is 300*l.* a year with an additional provision of a sum up to 100*l.* for each student for travelling while abroad. Reciprocal arrangements have now been made for the reception of students from the homeland at centres of research in Australia and New Zealand. This excellent provision is not the least important of the plans for securing good team-work within the Empire.

The field work of the council this year will be as follows: Cold-storage problems in co-operation with the British Food Investigation Board, with special reference to beef; liquid fuels, treatment of fuels for saving oil and other products by low-temperature distillation, Bergius process, etc.; forest products, continuation of researches on making paper pulp out of timber, utilisation of gums, resins, tannins, etc.; animal diseases and pests, blow-fly and buffalo-fly pests, diseases of cattle, sheep, and horses; plant diseases and pests, researches for checking the spread of prickly pear (29,000,000 acres in Australia now overrun by this pest).

The chairman of the council, Mr. Julius, is expected to arrive in England next year to discuss scientific and industrial problems of mutual interest to the homeland and to Australia. Thus, so far as Australia is concerned, the new council is already going strong.

In regard to New Zealand, on the recommendation of the Prime Minister, the Right Hon. J. G. Coates, the Parliament has adopted practically all of Sir Frank Heath's scheme as follows: An Advisory Council of Scientific and Industrial Research is to be formed, under the Prime Minister, for the general utilisation of science for the advancement of New Zealand's industries. It is also to co-ordinate and see to the proper maintenance of the Geological Survey, Magnetic Survey, Meteorological Office, the Hector Observatory, the Samoan Scientific Service, and a State Laboratory for Standards and Tests to include the present Dominion Laboratory. An agricultural college is to be built and an institute of dairying to be established to collaborate with it. Expensive buildings are not suggested, but much of the initial research work is to be done at the college laboratories. It is suggested that the Dairy Products Control Board share with the Government the cost of maintaining such a research institute.

In regard to forestry problems, of great importance to the Dominions and the Empire, in view of the alarming decrease in the supply of soft woods (Great Britain now imports 40,000,000*l.* of timber annually) it is recommended that a forestry institute be created, later, by the Government, assisted by the timber milling companies, and that meanwhile a general report on the whole question of the New Zealand forests be obtained from the ablest forester available. With regard to fuel resources, and how best to utilise the somewhat friable coals of New Zealand, a research student is to be sent at once to the Fuel Research Station of the Department of Scientific and Industrial Research at Greenwich. Then there is the hydro-electric problem: it is estimated that New Zealand has a potential supply of no less than five million continuous horse-power.

So much for the primary industries. For the secondary industries, two technical field officers are to be appointed to assist co-operative research associations, and particularly to advise the smaller industries. Arrangements are to be made for a scientific library to comprise the chief public and university libraries as well as some private libraries. New Zealand is advised to link itself up with the International Research Council by establishing a local National Research Council; and to found National Research Scholarships and grants to professors and others for research work.

The total grants for the last-named services are not to exceed 2000*l.* a year, while the initial cost of the council, apart from office charges, etc., is estimated to be about 7000*l.* a year. A scientific officer is to be attached to the Office of the High Commissioner of

New Zealand in London to act as a liaison between the Department of Scientific and Industrial Research and the new department in the Dominion.

The universities, the New Zealand Institute, and the Cawthron Research Institute all find places in the scheme, as well as the Department of Industry and Commerce. The Advisory Council is to be constituted much as in the Commonwealth, with this important exception, namely, that in view of the smaller distances to be travelled in New Zealand as compared with Australia, the meetings of the council are to be held monthly, the executive being left in the hands of the secretary of the council, a well-trained man of science, Dr. E. Marsden, until recently assistant director of education, formerly a fellow of the University of Manchester and professor of physics at Victoria College, University of New Zealand. A bill to give statutory effect to the above recommendation has recently been carried by the New Zealand House of Representatives.

Thus, in New Zealand, as in Australia, in the future application of science to the development of industry, the watchword is 'team-work,' as for the nations around the Pacific who meet triennially in the Pan-Pacific Science Congress, no less than for the League of Nations. For any work worth the doing the first essential is to find the man, and surely in the selected teams of Australia, and in the leader of the New Zealand Councils for Scientific and Industrial Research, the men have been found.

News and Views.

THE preliminary programme of the third Pan-Pacific Science Congress, which is to be held at Tokyo from Saturday, October 30, until Thursday, November 11, contains a provisional scheme and time-table of the work of the congress, a list of the excursions which have been arranged, lists of sailings, and other matter useful to those who propose to attend the meeting or to contribute to its proceedings. His Imperial Highness Prince Kotohito of Kan-in has consented to act as patron, and H.E. the Prime Minister of Japan will be president of the congress. There is a long and distinguished list of honorary vice-presidents, which includes the diplomatic representatives of the chief Powers, a number of the Japanese Ministers of State, and heads of universities. The arrangements for the meetings have been in the hands of an organising committee appointed by the Japanese National Research Council, under the auspices of which the congress is held. A change has been made in the organisation of the meeting itself to promote solidarity of feeling and action. There is no doubt that the change will also greatly facilitate the conduct of business in a congress covering so wide a field. The different branches of science have been classified into two broad divisions, the physical sciences and the biological sciences, instead of into sections and sub-sections for each branch of science as in previous congresses. Divisional meetings and joint divisional meetings will take the place of the sectional meetings. At these, discussions will take place between allied branches of science on subjects of more or less common interest, in other words on border-line problems. Sectional meetings will continue to be held, but taking quite a subordinate place — for the contributions of a special nature which from their scope are unsuitable for discussion at a divisional meeting.

THE character of the discussions at the congress must, to a great extent, depend upon the number and nature of the communications offered, but the organising committee has drawn up a provisional list of subjects. In the joint divisional meetings it is proposed to hold a symposium on certain plans for international co-operation in the study of the more important scientific problems of the Pacific, and, secondly, to survey the present state of knowledge of the physical and biological oceanography of the Pacific. The subjects suggested for divisional or sectional discussion cover a wide range in all branches of science, from astronomy to economic geography, agriculture, and medicine, in all cases with special reference to the Pacific. It is noticeable that there is a considerable bias in favour of topics which have a practical application. In the physical section meteorology, earthquakes, and the study of volcanoes take a prominent place. In the biological sciences the fauna and flora of the Pacific are to be discussed in relation to distribution, as well as from the practical point of view of protection, and, where appropriate, in relation to economic development. Anthropology is well represented in the discussion of the antiquity of man in the Pacific, the anthropometry of races of the Pacific, the study of Ainu, Papuans, and pygmies, the culture of the East Indies in relation to the question of 'diffusion,' and the relation of food, clothing, and houses to climate. A series of excursions has been arranged to suit the special interests of members of the congress extending from October 18 until November 19, which will include visits to Ainu villages, the famous shrine and temple at Nikko, Hakone volcano, Fuji, coal and copper mines, hot springs, cretaceous, tertiary, pliocene, and other geological formations in various localities, the old Imperial Palace and the University at Kyoto, as well as other places of importance for the study of the fauna and flora or the commercial and industrial activities of Japan. After the official excursions are over, facilities will be afforded for a longer stay if desired.

PROF. R. RUGGLES GATES, who has just returned to London after a visit to Russia, gives us some interesting information as to the position of some scientific work and institutions there. In the course of his letter he says that much valuable work is being done in the various plant-breeding stations which he visited. These included Tammisto, near Helsingfors, Finland, as well as Khibiny in Russian Lappland, north of the Arctic circle, which is devoted chiefly to the production of northern vegetables and oats for fodder; Peterhof and Desto Selo, near

Leningrad, where extensive genetical, biometric, cytological, and physiological investigations are being carried on, especially with cereals, under the direction of Profs. Philiptschenko, Vavilov, and Levitsky, and Drs. Pissarev and Karpetschenko; Petrovsky-Razoumovsky, where extensive experiments, particularly with oat-breeding, are being made by Dr. Schegalov; and Saratov, where the greatest interest attaches to a series of unique wheat-rye hybrids of Prof. Meister, and where Dr. Plachek is improving the varieties of sunflowers, which are extensively grown as a crop in Southern Russia.

IN Moscow, the Institute of Experimental Biology is one of several laboratories under the direction of Prof. Koltzoff, in which a great range of genetical and cytological as well as other experimental work in animal biology is being done. The genetical section is in charge of Prof. Tschetverikoff. Much eugenical work is also being done in Moscow and Leningrad, especially in the collection of pedigrees, and a *Russian Journal of Eugenics* is edited by Profs. Koltzoff, Liublinsky and Philiptschenko. The Timiriazev Institute in Moscow, under the direction of Prof. Navashin, is chiefly devoted to research in plant cytology and genetics. Prof. Gates also visited the Botanical Gardens in Leningrad, Tiflis, and Batoum, the chief interest of the Tiflis garden being its large collection of Caucasus plants. A study was made of the tundra vegetation in the far north and the steppe region in Southern Russia and the Caucasus. While in Moscow Prof. Gates was present at the opening of a small museum of Metchnikoff relics in the Institute of Experimental Pathology Madame Metchnikoff came from Paris for the occasion.

CONSIDERABLE interest has been aroused among archæologists by discoveries at Glozel, on the right bank of a rivulet called Le Vareille, about twenty miles south-east of Vichy, of which little had been heard in England until attention was directed to them by Prof. S. Reinach in a letter to the *Times* of September 27, in which he referred to their bearing upon the date of the Magdalenian culture. The excavations, which began in 1924 and were carried out by Dr. Morlet, assisted by a young peasant Émile Fradin, yielded last summer a curious combination of objects in association which is at least puzzling. The objects were of stone, bone, and more or less baked clay, without a particle of metal or Celtic or Roman pottery. They consisted of (1) a few polished axes and small flints (there is no flint in the neighbourhood): (2) very thick hand-made vases, one of them decorated with a human head (eyes and nose but no mouth), a fiddle-shaped figurine representing a woman, without a mouth and recalling the so-called owl-vases of Troy, (3) pebbles engraved with outlines of animals or inscriptions or both, in the most degraded Magdalenian style, (4) a large number of clay tablets covered with inscriptions, some long and well engraved. Of these inscriptions some are described as being like the Phœnician, but the greater number are quite different.

INSCRIPTIONS from so remote a period are not known if we except some of Piette's earlier painted pebbles from the Mas d'Azil and a few (apparent) graffiti on reindeer horn. The only similar inscriptions of anything like so early a date were found in Portugal in 1894; but these aroused some suspicion and have not been universally accepted. Prof. Reinach, to whom we are indebted for these details of the find, is of the opinion that we have here a religious deposit of early neolithic age associated with a degenerate Magdalenian culture which is thus brought down so late as 4000–3000 B.C., he holds that it points to the western origin of writing. Prof. Elliot Smith, in his presidential address to the Anthropological Society of University College, London, on October 15, referred to this curious association in one deposit of neolithic objects with Cretan affinities, Magdalenian objects, and a linear script. He suggested that if the neolithic phase did not begin in western Europe until the second millenium B.C., there was nothing inherently improbable in the association, but it necessitated cutting off one millenium from the dating on Prof. Reinach's view, that the close of the Magdalenian period might have been so late as 3000 B.C. Further, if the Ægean origin of the pottery was admitted, the claim for the western origin of writing was unjustifiable.

AT the Imperial College, South Kensington, on October 13, Dr. W. H. Keesom, professor of physics and director of the Cryogenic Laboratory in the University of Leyden, described the experiments by which he succeeded in solidifying helium in June and July last. The methods of refrigeration employed by the late Dr. Kamerlingh Onnes made it possible to attain a temperature of less than one degree above the absolute zero, and by applying great pressure at this temperature, Dr Keesom found it possible to reduce helium to the solid state Under the most favourable conditions a pressure of the order of 100 atmospheres was sufficient for the purpose. In the earliest experiments, in which the use of much higher pressures was contemplated, the solidification took place in a German silver tube, and was demonstrated by the indications of a differential manometer showing that the tubes had become blocked. In later experiments a glass vessel was employed, so that the solid helium could be seen. It was not distinguishable from the liquid to the eye, having apparently the same refractive index and density, but the existence of the solid was proved by the fact that a metal stirrer immersed in the substance became fixed. By means of a simple device for melting the helium in immediate contact with the stirrer, the latter was released, and could be hammered against the unmelted solid a short distance away. A curve of melting-point against pressure was drawn, and it was found that, unlike the corresponding curve for other substances, it did not meet the vapour pressure curve, and there was therefore no triple point. By extrapolation the melting-point curve was shown to become parallel to the axis of temperature at the absolute zero, in accordance with Nernst's heat theorem.

RECENTLY the International Education Board, founded by Mr. John D. Rockefeller in 1923, made an offer of 30,000*l.* towards the cost of erection,

equipment, and endowment of new premises for the Department of Animal Breeding in the University of Edinburgh, on condition that a similar sum was obtained in Britain. It was announced by the Principal of the University, Sir Alfred Ewing, on Thursday last that Lord Woolavington had given a sum of 10,000*l.* towards the endowment of a chair of animal breeding in the University, and that the Development Commission would make a substantial grant, so that the condition laid down by the International Education Board might now be regarded as fulfilled.

THE Board of Agriculture first suggested in 1913 that research in animal breeding should be undertaken in Edinburgh, and a joint committee, representative of the University and the College of Agriculture, was appointed to consider the matter in conjunction with the Board and the Development Commission. The organisation of the work was interrupted by the outbreak of the War, but was resumed in 1919, and towards the end of 1920 the Department of Animal Breeding was established with Dr F. A. E. Crew as director. It was first housed in the immediate neighbourhood of the Old College, but for the last two years has occupied laboratories in the new Department of Chemistry at West Mains, adjacent to which ten acres of pasture belonging to the University have been made available. The financial arrangements now announced will enable the Department to be provided with premises specially equipped for work on animal breeding, and as a site at West Mains is available, it is anticipated that the building of the new Department will soon be undertaken.

AT a meeting of the Society for the Study of Inebriety on October 12, Dr. J. D. Rolleston read a paper on alcoholism in classical antiquity in which he stated that, in view of the fact that the scientific study of inebriety dates only from the middle of the nineteenth century, very little is to be gleaned from contemporary medical writers as to the prevalence and effects of alcoholism in ancient Greece and Rome. The main sources of information are the poets, especially the gnomic writers and satirists, philosophers, moralists, and encyclopædists such as Pliny the elder and Athenæus. Though there is some indication of the existence of chronic alcoholism, as is shown by passages in Pliny and Seneca, alcoholism in classical antiquity was mainly of a convivial character, and industrial alcoholism, apart from that associated with prostitution, was unknown. Dr. Rolleston quoted numerous passages from the classical writers dealing with the dysgenic influence of alcohol and other evil effects of drink on the community and the individual, especially the relation of inebriety to insanity, crime and poverty, and the measures, often of a fanciful character, recommended by the ancients for the prevention and treatment of drunkenness. In conclusion, Dr. Rolleston pointed out that the alcoholism of classical antiquity differed from that of to-day by its predominance among the upper classes, the lack of legislative control, the absence of distilled liquors and the non-existence of syphilis, which is now often contracted as the result of alcoholic indulgence and runs a severe course in alcoholic subjects.

THE Innwerk Aluminium Co. has built an electric power station at Töging in Germany in order to utilise the various falls on the river Inn. It is the largest hydro-electric power station in Germany. It is estimated that the annual average output will be 465 million kilowatt-hours. A description of the equipment of this station appears in the July number of *A E G Progress*. A peculiarity of the scheme is that no provision is made for storage. The hydraulic energy is immediately converted into electrical energy. There is never waste due to water flowing uselessly over the weir. The amount of power available is so large that it cannot always be utilised for power and lighting. At the time the station was built it was doubtful whether it would be more economical to manufacture aluminium or nitrogen. Hence the electrical equipment was designed so that either direct current or alternating current could be obtained. At the Töging station there are 15 nine-thousand horse-power turbines. The first eight of these machines drive three-phase generators, whilst the other seven drive direct current dynamos, the output of which is used for the manufacture of aluminium, the furnace rooms for which are near the station. The alternating current is carried on overhead wires at 100 kilovolts pressure to the Hart carbide factory, which is ten miles away. Special precautions have been taken to prevent the pole wheel from bursting should a turbine 'run away.' They are made of steel cast in one piece, and two rings of Siemens Martin steel are shrunk on to them. The strength of this steel is 78,000 lb. per square inch.

THE fiftieth annual meeting of the Conchological Society of Great Britain and Ireland was held at the City Museum at Leeds on October 16 under the presidency of Mr. J. W. Taylor, the doyen of the Society. There was a large gathering of members, and a number of delegates from related societies attended with messages of congratulation and good wishes. The president in his address dealt with the evolution of the Mollusca, and there were various exhibits of interest, including the Stubbs Collection which has been recently acquired by the Museum. The Society was founded in Leeds fifty years ago within a few days by Messrs. W. Nelson, W. D. Roebuck, H. Crowther, and J. W. Taylor, and the last two were happily present at the jubilee, which was appropriately celebrated at Leeds, though the Society has had its headquarters at the Manchester Museum for some years past. Mr. Hugh Watson, of Cambridge, was elected president for the ensuing year.

THE newly-created Society of British Foresters held its inaugural meeting during the recent meeting of the British Association at Oxford. The object of this Society is to help in the technical development of forestry in Great Britain. Forestry is coming more and more into prominence, and it is felt that the time has now arrived for the establishment of an

association of those engaged in it and in allied sciences. A journal will be published, and this will provide a place for the publication of the results of forestry investigation and practice in Great Britain, and for the dissemination of results obtained elsewhere. The officers of the Society are: *President*, Mr. R. L. Robinson, *Vice-President*, Prof. R. S. Troup; *Members of Council*, Mr. C. O. Hanson, Major F. M. Oliphant, Mr. R. S. Pearson, Mr. Frank Scott, Mr. J. D. Sutherland, Dr. Malcolm Wilson; *Editor of Journal*, Dr. H. M. Steven; *Business Editor*, Mr. J. Lyford Pike; *Secretary and Treasurer*, Mr. R. Angus Galloway, 8 Rutland Square, Edinburgh.

THE following courses of lectures have been arranged at the Royal Institution during November and December. The Tyndall Lectures will be delivered by Dr. G. W. C. Kaye, who will commence a course of three lectures on the acoustics of public buildings on Tuesday, November 2, at 5.15, and on Tuesday, November 23, Sir William Bragg begins a course of four lectures on the imperfect crystallisation of common things. On Thursday afternoons, beginning on November 4, there will be two lectures by Sir Edgeworth David on Antarctic exploration of the past and future; three by Dr R. R. Marett on the archæology of the Channel Islands; and two by Sir Squire Sprigge on (1) early medical literature and (2) medical literature in relation to journalism. On Saturday afternoons, November 27 and December 4, at three o'clock, Dr G C Simpson will give two lectures on atmospheric electricity. The Juvenile Lectures this year, the hundred and first course, will be delivered by Prof A. V. Hill on nerves and muscles, how we move and feel: (1) Nerves and the messages they carry (Dec 28); (2) muscles and how they move (Dec. 30), (3) the heart and some other muscles (Jan. 1), (4) the lungs and blood (Jan 4); (5) nerves and muscles working together (Jan. 6), (6) speed, strength, and endurance (Jan. 8).

THE ninth annual Streatfeild Memorial Lecture will be delivered by Mr F C. Robinson at the Institute of Chemistry on Friday, November 19, at 8 P.M. His subject will be "The Chemist in the Non Ferrous Metallurgical Refinery," and Prof. G. G. Henderson, president of the Institute of Chemistry, will take the chair. Tickets of admission are obtainable on application to the Registrar, Institute of Chemistry, 30 Russell Square, London, W.C 1 Frederick William Streatfeild was on the staff of the City and Guilds Technical College, Finsbury, from its foundation until his death in March 1918, as a teacher of applied chemistry. He won the esteem and affection of several generations of Finsbury students, who established a fund for the provision of an annual memorial lecture to mark their appreciation of his work and worth. Previous Streatfeild Memorial lecturers have been: Sir William Pope (1918), Prof. G. T. Morgan (1919), J H. Coste (1920), W. P. Dreaper (1921), Prof C. H Desch (1922), E. M. Hawkins (1923), Julian L. Baker (1924), and Francis H. Carr (1925). On the closing of Finsbury Technical College, the administration of the Fund and the arrangements of the lecture were entrusted to the Institute of Chemistry.

FARADAY House Testing Laboratories, Southampton Row, London, W.C.1, have issued a scale of fees for testing mechanical, electrical, and chemical materials, instruments, and machinery. Arrangements are also made for the loan of instruments, workshops, for investigations and reports, and for advice and assistance to inventors.

Two of the best signs of activity and vigour of the optical industry in Great Britain are the number and importance of the scientific papers which are published by optical firms. We have before us a list of fifteen or sixteen publications which have appeared in scientific and technical journals during the last two years from Messrs. Hilger's workshop. Of these, nine were papers read at the recent Optical Convention, two deal with the lens interferometer and its use, two with spectrum analysis and spectrographs, and one with a new measuring micrometer.

WE much regret the appearance of a misprint in Dr. K R. Ramanathan's letter in NATURE of September 4, p 337. Observations at Simla referred to near the end show that polarisation for the red reaches values so high as 87 per cent, and not 30 per cent as printed.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in organic chemistry and an assistant lecturer in geography in the University of Birmingham—The Secretary (October 30) A lecturer in electrical engineering at the Chesterfield Technical College—The Director of Education, S. Mary's Gate, Derby (October 30) A lecturer in agricultural botany at Armstrong College, Newcastle-upon-Tyne—The Registrar (November 6) An assistant lecturer in botany in the University of Birmingham—The Secretary (November 6) A scientific officer for, primarily, research in connexion with electrical ignition appliances at the Royal Aircraft Establishment, South Farnborough—The Chief Superintendent, R A E, South Farnborough, Hants (November 10, quoting No. A. 81). A professor of zoology in the University of Birmingham—The Secretary (November 22). An engineer to take charge of the section of wood preservation of the Forest Products Research Laboratory at Princes Risborough—The Secretary, Dept of Scientific and Industrial Research, 16 Old Queen Street, S.W 1 (December 1). A reader in wireless telegraphy and high-frequency technology at the Indian Institute of Science, Bangalore—Dr. W H. Eccles, Institution of Electrical Engineers, Savoy Place, W C.2. A woman B.Sc., biology, physiology, and biochemistry, and preferably physics or mathematics, for work at the Wellcome Physiological Research Laboratories, Beckenham—The Director. An assistant agricultural botanist under the Linen Industry Research Association—The Secretary, Research Institute, Lambeg, Co. Antrim. A head of the physics department of Huddersfield Technical College—The Director of Education, Education Offices, Huddersfield.

Our Astronomical Column.

RECENT SUNSPOTS AND MAGNETIC STORM.—Although no unusually large spot has appeared as yet this month, the sun's disc has presented a striking feature, consisting of a procession of four large groups of spots in the northern hemisphere. Some of the spots were occasionally naked-eye objects to keen vision, but as they kept just on the limit of visibility they have not been included in the list of the largest spots given from time to time in these columns. Their approximate positions will be of interest to observers, however, and are tabulated as follows:

Group.	Central Meridian Passage.	Longitude.	Latitude	Area.
a	Oct 9·2	232	15° N	700
b	11·2	205	18 N	900
c	13·7	173	16 N	600
d	16·7	133	24 N	650

(The areas, corrected for foreshortening and expressed in millionths of sun's visible hemisphere, were measured on Oct 13.)

Group *d*, comprising a roughly circular spot with small companions, represents the return of the large September spot No. 10.

On Oct. 14, at 20^h, the commencement of a magnetic disturbance was recorded at Greenwich, which continued for about 12 hours, the greatest deflexion of the declination needle being about 0·5°. At 19^h on Oct 15 a recrudescence of the disturbance took place which rapidly developed into one of great magnitude, the declination traces showing extreme deflexions of more than 1°. Serious difficulties in telegraphic transmission were experienced at the same time, and a display of the aurora was reported from America. At the time of the commencement of the preliminary disturbance, the longitude of the sun's central meridian was 157°, and at the commencement of the great disturbance it was 145°. As will be seen from the above table, the present instance is an example of the considerable uncertainty in ascribing a relation between a particular sunspot and a magnetic storm, judging merely from the position and appearance of the spot. Spectroscopic observations may, of course, come to hand which will throw some light on the matter.

It may be added that the general activity of the sun is still increasing. Apart from the occurrence of spots and faculæ, this fact is shown by the prominences during the last three months. Mr Newbegin reports that, for the past three weeks, the average number per day he has observed spectroscopically at the sun's limb is 20.

UNUSUAL DISPLAY OF LARGE METEORS.—Mr W. F. Denning writes that during the three nights Oct. 9 to 11 four brilliant meteors were observed by himself or friends at Bristol, and that three recorded paths indicated a well-defined radiant in Corona at 230° + 33°.

On the evening of Oct. 9 at 20^h 30^m G.M.T. a bright meteor, equal to twice the apparent magnitude of Jupiter, was seen in Draco moving from 244° + 47° to 261° + 59°, motion rather swift. On the same evening at 22^h 20^m a fireball, three or four times the brightness of Venus, appeared in Auriga, falling approximately from Auriga to low in the N.W. It left a long vaporous trail which remained visible for ten minutes or more. Near the end of its flight it gave a great outburst of light which illuminated the sky and land. This brilliant object had a radiant at about 262° + 55° and was probably a fragment of Giacobini's comet of 1900. The comet has a radiant at 253° + 56° as computed by Rev. M. Davidson, and its orbit is nearest to the earth (distance $5\frac{1}{2}$ millions of miles) on Oct. 9.

On Oct. 10 at 20^h 20^m a slowish meteor equal in brightness to Venus traversed part of Cygnus, crossing the stars ϵ and ξ Cygni, the path being from 318° + 30° to 333° + 32°. It left a bright streak for several seconds and burst with a strong flash when between the two stars mentioned.

On Oct. 11 at 21^h 17^m a meteor as luminous as Jupiter appeared in Perseus, and shot from 53° + 43° to 53° + 23°.

It is an unusual circumstance to get a radiant from brilliant meteors alone. A singular abundance of fireballs has, however, diversified the present season since September 6. They have been directed from a number of different showers, though several have apparently had their origin in radiants near the N.E. and N.N.E. region of the horizon. Corona, as a radiant of meteors in October, is quite unknown, for that constellation is low in the N.W. in the evening hours and sets before 23^h at this time of the year.

COMETS.—The comet Giacobini-Zinner, discovered in 1900, and seen again on its second return in 1913, has been detected by Dr. Schwassmann at Bergedorf on Oct. 16, 17^h 50^m U.T., in R.A. 17^h 24^m 52^s, N. Decl. 2° 32′, magnitude 14·0. The indicated value of T, the perihelion passage, is Dec. 11·77, 1926, about four days later than Mr. Cripps's predicted date. His other elements are: ω 171° 44′ 8″, Ω 105° 56′ 35″, *i* 30° 43′ 4″, ϕ 45° 47′ 29″, log q 0·90726, equinox 1926·0.

EPHEMERIS FOR 0^h U.T., CORRECTED BY ABOVE OBSERVATION

	R.A.	Decl	log *r*.	log Δ
Oct. 24	17^h $15·1^m$	0° 35·1′ N	0·0836	0·1358
Nov. 1	18 9·9	1 38·5 S	0·0618	0·1212
,, 9	18 37·9	3 55·9	0·0415	0·1061
,, 17	19 8·6	6 15·3 S	0·0239	0·0908

This makes the sixth comet to pass perihelion in 1926, four being periodic and two parabolic.

Neujmin's Comet is expected to pass perihelion on January 2 next; however, if a doubtful object observed by Mr. Neujmin in 1920 was really his comet, the date will be 22 days later. The following ephemeris for 0^h is by Mr. B. F. Bawtree, on the earlier assumption:

	R.A.	N. Decl.
Oct 23	9^h $59·3^m$	18 34′
,, 31	10 23·3	15 48
Nov 8	10 47·3	12 45

As two revolutions have taken place since discovery, there is considerable uncertainty in the positions. The comet is likely to be faint.

Mr. J. Polak, of Saratov, had investigated the perturbations of Holmes's comet, discovered in 1892, and seen again in 1899 and 1906, but not since then. Dr. Zwiers calculated its perturbations up to 1906, but after his death no one continued the work. Mr. Polak shows that the Jupiter perturbations in 1908 were very large, increasing the period by 6 months, and diminishing the eccentricity from 0·412 to 0·379. This explains the failure to find the comet in 1913 and 1919. The return in the former year was a very favourable one, and an ephemeris is given in *Astr. Nach.* 5465. The general region is Aug. 4, R.A. 1^h 0^m, N. Decl. 20°; Oct. 3, R.A. 0^h 34^m; N. Decl. 30°. Plates of that region taken in 1913 should be examined for images of the comet.

The perturbations since 1908 have been small and the next perihelion passage will be near March 12, 1928. The comet may be seen (especially by southern observers) in the autumn of 1927. As this is one of the few comets discovered in England it is satisfactory to find that work on it is resumed.

Astr. Nach. 5466 contains an interesting study of the brightness of comet Tempel II in 1925. During the month of July it brightened up four magnitudes, from 10·5 to 6·5, log *r* changed from 0·14 to 0·12, and log Δ from 9·58 to 9·51. These changes are so small that it is clear that the brightening was mainly due to physical change in the comet. One may conjecture that at greater distances the sun's physical effect on the cometic envelopes is insignificant, but that it becomes important at a certain point (not apparently the same for all comets), and henceforth develops rapidly with approach to the sun. It is, however, difficult to frame laws that will cover all cases.

Research Items.

ESKIMO ENGRAVINGS ON WALRUS IVORY.—Three examples of Eskimo art from Alaska of a type rarely seen in Europe are described by M. L. Giraux in the *Journal de la Société des Américanistes de Paris*, N. Sér. T. 18. The objects in question are made of walrus ivory, measuring 31 cm., 33 cm., and 36 cm. in length respectively, and are engraved and painted or stained in colour with human and animal figures. Among the human figures is that of a male in European clothing. All the figures are realistic, but the animals in particular exhibit an intimate acquaintance on the part of the artist with their characteristic attitudes and habits. Although all the Eskimo of Alaska show considerable dexterity in carving wood, bone, ivory, and reindeer horn, the inhabitants of the coast from the Yukon delta to the lower Kuskokwin river are particularly noted for their artistic skill. The technical methods employed in dealing with the ivory of a walrus tooth in the days before the introduction of iron and steel implements, are of considerable interest, especially in view of the marked resemblance of the objects under consideration to palæolithic engravings. Four grooves were made in the tooth with a piece of quartz or other siliceous stone. When these had been made as deep as the form of the cutting edge of the stone implement allowed, the two pieces were flaked off either by simple pressure of the hand or by means of a wooden knife-blade-like implement, which was inserted in the groove. The central piece of ivory thus obtained was rubbed down to the required shape by a freshly broken stone. The perforation found in some of the objects was then made by a stone drill and sand, working in a slight depression previously made, and actuated by a cord or strap. The polishing was done either with a very fine-grained stone (soapstone) or by the hand used with very fine-grained sand. Lastly, another piece of ivory was employed to produce a high polish. The gravers were sharp pieces of stone, flint, quartz, schist, or soapstone, usually fixed in pieces of wood, each material requiring a special method in manufacturing the graving tool. The colours employed were black (plumbago and charcoal or gunpowder mixed with blood), red (oxide of iron or ochreous earth), yellow (ochreous earth), white (argillaceous clay), and green (oxide of copper). A dark reddish brown used for staining seal skin was obtained by macerating the inner bark of alder in urine for twenty-four hours.

AN ENDEMIC FLORA.—An unusual analysis of an endemic flora will be found by F. Lewis in the *Annals of the Royal Botanic Gardens, Peradeniya*, vol. 10, part 1. With the data given in Trimen's "Flora of Ceylon," and from his own observations as to altitude, the author has analysed the distribution of the large endemic flora in relation to its distribution at different altitudes. The result is that the greater number of endemics are to be found at the foot of the hills instead of at the highest altitudes, a conclusion which the author briefly discusses, assuming that in the more densely populated lower levels the struggle for existence is greater, and natural selection has thus operated more vigorously.

JAPANESE BOTANY.—The botanical output of Japan proceeds apace, and fortunately abstracts will be found of practically all publications in the *Japanese Journal of Botany*. A brief notice of some of the interesting papers is all that can be attempted here. Yoshiji Yoshii has published a very extensive study of the maturation of the seed of *Pharbitis Nil*. The process of maturation can be divided into a series of stages; the chemical changes, water content, etc., of the seeds were studied and also their capacity to germinate when tested at these different stages. (*Journ. of Faculty of Science, Tokyo*, Section III. vol. 1, Part i.). Isaburo Nagai publishes four papers upon mutations in *Oryza sativa* L. in the *Japanese Journal of Botany*, Vol. 3, No. 2; in the same journal Kametaro Oharo has a paper upon Japanese fossil conifer woods, which he has been studying at the palæobotanical institute at Berlin, and there are two cytological papers upon pollen development, that by Tetsu Sakamura and Isamu Stow, dealing with the experimental production of pollen grains with abnormal chromosome numbers in *Gagea lutea*. In the previous issue of the same journal, Ichiro Ohga has an interesting paper upon the structure of ancient but still viable fruits of the Indian Lotus. The author began these studies in Manchuria, and continued them at Tokyo and then at the Johns Hopkins University, at Baltimore. These old lotus fruits occurred in a peat bed in the Pulantien Basin, in South Manchuria, and are probably at least three or four hundred years old. The retention of viability for such a long time is probably due in large part to the approximate maintenance of the water and gas content in the tissues of the embryo, due to the structure of the fruit coats and their maintenance in the undisturbed condition of the peat bed. A very full account of the life history, fertilisation and cytology of the fungus *Plasmopara Halstedii*, is given by Prof. Makoto Nishimura in the *Journal of the College of Agriculture*, Hokkaido Imperial University, Sapporo, Vol. 17, Part I, with five plates of drawings which are well reproduced. Koki Masui has a paper upon the mycorhizal relation of the fungus *Cantharellus floccosus*, Schw. with the roots of *Abies firma* in the *Memoirs of the College of Science, Kyoto Imperial University*, vol. 2, No. 1, 1926. It seems clear that this fungus is definitely parasitic on the tree, in many cases killing branches of the root.

CORALS AND SEDIMENTS.—Problems of sedimentation and rock formation in tropical, coral-bearing regions constitute the subject-matter for research in vol. 23 of the papers from the Department of Marine Biology of the Carnegie Institution of Washington. M. N. Bramlette, in dealing with some marine bottom samples from Pago-Pago harbour, Samoa, describes the nature of present sedimentation processes in and around the harbour. Chemical and mechanical analyses of the samples are given and discussed and, in some cases, a detailed analysis of the organic constituents has been made. Borings from the reef were also examined and, on comparison with the bottom samples, shown to be relatively richer in magnesium carbonate. A study of reef-sand from the Bahamas by M. I. Goldman is concerned chiefly with the problem of dolomitisation. The chemical composition of the sand was determined directly and also by calculation from a count of the different constituents of known composition, mainly calcareous skeletons. The difference found is taken to represent a change in chemical composition, the results in the present case indicating a relative decrease in the amount of magnesium carbonate. The results are not considered conclusive, however, and suggestions are put forward for other methods of investigation. N. R. Smith, reporting on a bacteriological examination of 'Chalky Mud' and sea water from the Bahama Banks, classifies the bacteria found and describes an experiment to show that calcite is precipitated from sea water as a result of bacterial growth when food is supplied and when the supply of calcium in solution is maintained by the addition of calcium sulphate. He states also that calcite is formed from natural sea water by the strong ammonifying vibrios found in the mud, the only addition required being organic

nutritive matter. J. A. Cushman supplies a list of some recent Foraminifera from Porto Rico with notes on their distribution. An account of some late Miocene or early Pliocene mollusca and sharks' teeth from the Fiji and Tonga Islands by W. C. Mansfield, is accompanied by a useful annotated bibliography of the geology of the Fiji Island. T. W. Vaughan and J. E. Hoffmeister describe some Miocene corals from Trinidad, mostly new species.

Vortex Distribution behind an Aerofoil.—Lanchester, in his "Aerodynamics," vol. 1, indicated from general theoretical considerations that the flow in the wake of an advancing aerofoil of finite span should comprise a layer of vorticity immediately behind the trailing edge and two general circulatory motions of opposite directions of rotation, one at each tip. Broadly speaking, this prediction has stimulated investigations at Gottingen, in America, and at the National Physical Laboratory at Teddington, receiving ample verification. In Aeronautical Research Committee Report, R and M. No 951 (H.M. Stationery Office, 1s. net), Messrs. Fage and Simmons have subjected this theory to an accurate quantitative test and mapped out the changes which occur in the vortex distribution in the wake of an aerofoil. The result provides an experimental verification of the theoretical relation given by Lanchester, that the total strength of the vorticity leaving a semi-span of an aerofoil, as obtained by integration over the transverse plane close behind the aerofoil, is equal to the circulation around the median section, and that the distribution of vorticity is in close association with the distribution of lift along this span. At 13 chords behind the aerofoil the rolling up of the vortex band is practically complete and, within the limits of experimental error, at a distance of 0·57 chords in front of the aerofoil the flow is irrotational The theory thus verified has undoubtedly given a new impetus to aeronautical developments.

Cathode Sputtering.—In the *Ann. der. Phys.*, No 15, p 672, 1926, A. von Hippel describes a new method for the investigation of cathode sputtering, and he shows that sputtered metal particles consist, at any rate to a very large extent, of uncharged atoms. In his experiments a cadmium cathode was usually employed, but experiments were also carried out with silver and zinc cathodes. The particles emitted from the cathode collide with ions and electrons, and if they were atoms they would emit their resonance lines Thus, if the resonance lines of the cathode material are observed close to the plate, which lies outside the dark space, on which the sputtered particles are deposited, then we have evidence of the atomic nature of the particles. Clear proof of this was obtained, however, by comparing the intensity of the cadmium 3261 line with the intensity of the mercury 2537 line, when the vapour pressure of the mercury inside the sputtering chamber was known. From these observations the vapour pressure of the sputtered particles was calculated, and the value thus obtained agreed, within the limits of experimental error, with the value obtained from calculations based on a knowledge of the thickness of the sputtered film and on the assumption that the particles were atoms. Incidentally it was found that sputtered cadmium absorbed mercury vapour very rapidly.

Age-hardening of Aluminium Alloys.—It has been shown that the alloys of aluminium with manganese and silicon possess the property of age-hardening after quenching from a high temperature, and also that alloys of aluminium with copper show age-hardening to a lesser degree. In the first part of a paper by Kathleen E. Bingham read at the Liège meeting of the Institute of Metals on September 3, and entitled "The Constitution and Age-hardening of some Tenary and Quaternary Alloys of Aluminium containing Nickel," it is shown that the tenary alloys of aluminium with copper and nickel do not possess this property of age-hardening in any appreciable degree. This suggests that the addition of nickel to the alloys of aluminium with copper suppresses the phenomenon of age-hardening. This is explained by the constitution of the alloys, since the property of hardening depends on the precipitation of one or more of the constituents, and it has been shown that with 2 per cent. of nickel and about 6 per cent. of copper there is no $CuAl_2$ present, either at 500° C. or on cooling slowly to 200° C.; *i.e.* 2 per cent. of nickel increases the solubility of $CuAl_2$ in these alloys at both high and low temperatures. Finally, it is shown that the addition of 1 per cent. manganese to the alloys of aluminium with copper and nickel causes the precipitation of a large amount of magnesium silicide on cooling from 500° C. to 200° C., and also affects slightly the solubility of $CuAl_2$ and $NiAl_3$. In the series containing 4 per cent. copper, 2 per cent. nickel, and 1·5 per cent. magnesium, marked age-hardening takes place, and it is suggested that it is due chiefly to the precipitation of magnesium silicide, since it has been seen that any due to the $CuAl_2$ is very slight. One per cent magnesium is already in excess of the amount required for the formation of the compound Mg_2Si, as there is only about 0·13 per cent. silicon in the aluminium used.

Testing of Hardened Steel.—The testing of high carbon tool steel has hitherto been carried out almost entirely in the form of actual machine tests on tools made from the steel. Axel Lundgren, in a paper read at the Stockholm meeting of the Iron and Steel Institute describes a simpler test. The type of test adopted was a bend test, carried out in a machine specially designed for this work. Steels with more than 1 per cent. of carbon annealed in such a manner that the cementite was in a fine-grained form, show, after subsequent hardening and tempering, a higher bend strength and a higher resistance to impact than specimens which, before hardening, have been so annealed that coarse-grained cementite has developed. An annealing which yields a cementite in a spheroidised condition will, after hardening, yield a steel consistently tougher than will a treatment which resulted in the cementite appearing in the form of a network, and this despite the fact that the cementite has afterwards disappeared. Steel with the highest percentage of carbon, 1·3 per cent., shows, after hardening and tempering, a higher bend strength than do lower carbon steels. Annealing so as to produce a fine-grained cementite results, when the steel is hardened and tempered, in the production of a higher bend strength than is obtained from an unannealed steel. The steels quenched at too high a temperature and then tempered at a temperature of 150° to 200° C. show a reduced bending strength, particularly when the tempering temperature is lower. So far as hardness is concerned, the steel with 1·3 per cent. of carbon is slightly harder after heat treatment than the 0·9 per cent. carbon steel. The difference is not great, but with lower carbon contents a rapid decrease in hardness is recorded. Similarly, a slightly greater hardness has been observed in the specimens which were not annealed before hardening, than from those which had been annealed. The influence of the rate of cooling upon the ultimate bending stress, after tempering, has been tested with a tempering temperature of 300° C. In this connexion it has been found that in the case of very rapid cooling in benzene, a much lower bending strength was obtained, than in the case of a less rapid cooling in air.

International Congress of Psychology.

THE eighth International Congress of Psychology was held at Groningen on September 6-11. Nearly 250 psychologists attended. All appreciated the arrangements made by the national committee, consisting of Profs. Heymans (president), Wiersma, Roels (secretary), Brugmans (2nd secretary), Bouman, Buytendijk, Zwaardemaker, and the late Prof. van Wayenburg, and especially by the local reception committee. On the social side, concerts and other entertainments and excursions were arranged, and the reception by the Municipality of Groningen in the Stadspark was a brilliant function.

More than eighty papers were read Mention may be made of a symposium on intensity differences of sensation, which was opened by Dr. C. S. Myers (London), and Prof. Werner (Hamburg).

Dr. Myers showed how the study of spinal reflexes contributed to our knowledge of intensity differences. As the strength of a stimulus increases, not only does each muscle contract with greater vigour, but *additional* muscles are also brought into play. Moreover, when the stimulus becomes strong enough, the original reflex may be suddenly transformed into another. Thus if the skin between the pads and cushion of the dog's hind foot be pressed or stretched in the spinal animal, the leg is reflexly *extended*. But if the stimulus becomes sufficiently powerful, this reflex changes into one totally different, and the leg is reflexly *flexed*. Instead of inducing contact with the stimulus-object, the stimulus now evokes escape from it. Instead of being, as before, related to the act of walking, the reaction now has reference to that of flight. The sensation passes from one of touch to one of pain. Corresponding to such an abrupt change in type of reaction, the whole pattern of events in the spinal cord must be supposed to undergo an equally abrupt change. The evidence thus points to sensational intensity being in actual experience inevitably an impure variable. Just as with increase of a reflex stimulus the latter spreads to other reflexes, so, as we increase the strength of a tonal stimulus, new sensations inevitably arise, it alters not merely in intensity but also in timbre. It is indeed seldom, if ever, possible that a stimulus is so weak (or so pure) as not to affect mixed sensory elements.

Yet another feature of reflex action is that, when a stimulus provokes reflex flexion of a limb, it simultaneously inhibits antagonistic reflex extension of that limb. If proven applicable to the sensory field, this means that increase of one sensation is accompanied by decrease of an opposite sensation, *e.g.* warmth and coolness, red and green, blue and yellow, white and black. In the white-black pairs there is even a gradual transition from one pure pattern to the other pure pattern through every degree of admixture. It is therefore not surprising that so much discussion has been evoked as to whether changes in the white-black series of sensation are to be regarded as changes in quality or in intensity of sensation. The true answer is that both are inevitably simultaneously changed; or, as Dr Myers long ago pointed out (*Brit. Journ. of Psychology*, Oct. 1913), intensity differences may be regarded as neither qualitative nor quantitative, but strictly *sui generis, i.e.* intensive.

Prof. Spearman (London) communicated some results obtained from his well-known doctrine of noegenesis, according to which all cognitive operations can be analysed into a system of ultimate laws and processes. These processes were sharply divided into two kinds, the insightful and especially the *eductive* processes, and those which are merely *reproductive*. Thus in the study of individual differences of ability, all current tests of intelligence may be analysed into their eductive and reproductive constituents. The former has shown itself to involve one single general factor, and if anything is to be given the title of 'general intelligence,' it can be nothing else than this. As for the other or reproductive kind of process, this has proved to be wholly independent of the general factor. Thus eduction and not reproduction is the only trustworthy basis of a successful mental test. In the same way the operations involved in the so-called learning by trial and error admit of analysis into the two kinds of constituents, eductive and reproductive, and are far from being 'mechanical,' as generally supposed. The topic of error is another field illuminated by this doctrine. An exhaustive examination of every sort of belief that can unquestionably be regarded as erroneous—from the highest chains of reasoning down to the merest tricks of illusion—every one of them prove to rest primarily upon the law of retentivity and the process of reproduction. All purely noegenetic processes are incapable of error in the slightest degree.

The doctrine of noegenesis also enables the whole range of cognition to be surveyed, and such ancient 'faculties' as 'memory,' 'imagination,' 'attention,' and so forth, as well as such modern ones as 'the power of censorship' or 'keenness in breaking up a complex'—always resolve themselves without the smallest remainder in terms of ultimate psychological laws.

Demonstrations were given by Dr. Godefroy (Amsterdam) on the principles of electrotachography. His method of investigating the psychogalvanic reflex is essentially the transformation of the galvanogram obtained by the Veraguth-Waller method into its first differential or speed curve. Into the circuit which is led through the person tested, the primary coil of an alternating current transformer has been introduced, while the secondary is connected directly with the galvanometer. Thus whenever a change of intensity of the primary current takes place the galvanometer shows a deflexion, and the ordinates of the curve obtained are proportional to the rapidity of the changes in intensity of the primary current. There is also the advantage that the galvanometer returns to zero after each tachographic deflexion. There is, however, at present considerable difference of opinion as to the cause of the psychogalvanic reflex. Dr. Godefroy's experiments lead him to support the hypothesis of the emotional genesis of the phenomenon. Dr. Aveling (London), however, after elaborate experimentation, concludes that the psychogalvanic phenomenon is characteristically the consequent of conation.

Several interesting exhibits and demonstrations were given of various apparatus, designed by Prof. Zwaardemaker of Utrecht, which are well-known to psychologists and to nose and ear specialists, namely, various kinds of olfactometers, an apparatus for demonstrating the presence of odorous molecules in the air, etc.

Prof. Zwaardemaker has recently designed an apparatus for the reinforcement of speech on behalf of the deaf by audions and thermotelephones. The choice of the microphone, the valves and the transformers is a matter of knowledge of modern radio

telephony, but Zwaardemaker, not content with subjective listening at the thermotelephone, secured objective measurements by employing the Rayleigh principle of the acoustic mirror.

In conclusion, the records of the Congress point to activity along lines already initiated, and there was little evidence of the breaking of new ground. Thus the researches of the 'configurationists,' useful as they are, as a contrast to the work of some 'atomists,' could yet be assimilated by many outside their camp without sacrificing any psychological principles. LL. W. J.

Coal Blending.

THE gradual exhaustion of the more easily mined seams of coal in Great Britain, and other factors which are resulting in increasing costs of mining and transport, are combining to focus attention on the necessity of employing more scientific methods in the preparation and utilisation of coal. In coal carbonisation, the main object of the coke oven is to produce coke possessing the special properties required by the metallurgical industries; whereas the chief aim of the gas industry has been to manufacture gas of the quality required for domestic and industrial purposes, and coke as a secondary product has not received the attention it deserves. The possibility of producing coke with the qualities desirable in a solid smokeless fuel for domestic use is now being realised, and coke quality and structure are consequently being given much more consideration.

Many attempts have been made to manufacture a solid smokeless fuel, containing a comparatively high percentage of volatile matter, by the carbonisation of coal at low temperatures, and satisfactory products have been obtained, but the costs of the processes have been so great that it has not yet been possible to establish them on a sound commercial basis.

In high temperature carbonisation processes, largely on account of the low thermal conductivity of coal, the charge adjacent to the retort walls is fully carbonised before any marked decomposition of the coal in the centre of the charge has commenced. The exposure of the coke to high temperatures for long periods, and the small amount of volatile matter, both operate in the direction of rendering the product difficult to ignite. The work of numerous investigators, however, has led definitely to the conclusion that these are not the only factors which influence the quality of coke as regards relative ignitability, combustibility, and reactivity. Other factors of importance include the character of the coal carbonised, the state of division of the coal, the method, speed, and duration of heating and the temperature of carbonisation.

The character of the coal to be carbonised may be controlled by grinding and mixing coals of different coking properties with one another or with coke breeze or other substances, in predetermined proportions. The main effects of efficient blending are more rapid heat penetration of the charge and the production of a harder and more easily combustible coke. The method, speed, and duration of heating are largely determined by the design of carbonisation plant.

In a recent paper to the Iron and Steel Institute,[1] Mr. David Brownlie presents a useful survey of the subject of coal blending; that is, the mixing of coals with one another and with other carbonaceous materials, such as low temperature fuels, coke, pitch, etc., especially in connexion with carbonisation. A summary of the paper is not attempted in this article, since the paper, although extending to forty-two pages, is in itself a summary, and the titles of the sections alone occupy more than one page.

Some coking coals are so constituted that they do not require blending for the production of good high temperature coke, but the amount of coal of this type is limited. Scientific blending would render many more coals available for use in the carbonisation industries. It must be emphasised, however, that the blending of coals on a commercial scale requires close attention, as the correct blend for a particular process and temperature of carbonisation would not necessarily be suitable for other processes or temperatures. Other factors, in addition to the amounts of resinous material in the coals constituting a blend, must also be taken into account. For example, the investigations of the Joint Research Committee of the University of Leeds and the Institution of Gas Engineers have shown that the degree of fineness of the coal carbonised exerts important influences. Further, the work of C. B. Marson and J. W. Cobb has demonstrated that the character of the coke may be influenced considerably by the nature of the ash constituents. Iron oxide, calcium oxide, and sodium carbonate have marked beneficial effects, but certain other substances examined were apparently inert.

The application, on a commercial scale, of the results obtained in laboratory investigations of coal blending presents certain difficulties. In addition to the installation of grinding and mixing machinery, increased bunker capacity would be required. It would also be necessary to ensure that only small variations in the quality of coal from a particular colliery occurred in different consignments. The advantages obtained by blending must also compensate for the additional cost of the preparation of the blends, and in this connexion it must be pointed out that the depreciation of grinding machinery, when coke is one of the constituents of the blend, may be considerable. A. PARKER.

[1] Coal Blending: A General Review of Principles as Applied both to High and Low Temperature Carbonisation, by D. Brownlie. Iron and Steel Institute, June 1926.

Physical Phenomena and Molecular Orientation at Interfaces.

THE behaviour and properties of interfaces were discussed at a conference arranged by the Faraday Society on October 1. The subject is of fundamental importance in the science of colloids, and it is only by a better appreciation of the former that we can hope to unravel the peculiarities of such complex systems as are to be found in natural colloidal materials. The liquid-gas and liquid-liquid interfaces are more simple than those containing a solid surface, since liquids present equipotential surfaces. There is little doubt that the concept of a unimolecular layer of orientated molecules as constituting the surface layer of an insoluble oil on the surface of water is correct, and many investigations are being made on the conditions of formation and stability of these orientated, two-dimensional systems in their solid, liquid, vapour, and gaseous states of aggregation. All the usual three-dimensional phase phenomena, such as allotropy or the process of vaporisation, have been shown to have their two-dimensional prototypes. For soluble substances the surface composition can only be calculated by means of the Gibbs' equation, a

thermodynamic process which gives no information as to the dimensions or orientations of the surface phase. That within certain ranges of bulk concentrations, however, the Gibbs' layer is unimolecular, is made probable by experiments on sparingly soluble fatty acids and the analogy between the properties of the surfaces of solution and three-dimensional gases.

This simple idea, however, does not appear to be applicable to all types of binary mixtures; it is possible that in some solutions the Gibbs' layer is thicker than one molecule, but reasons for and against are founded as yet on but slender arguments. The kinetic interpretation of the lowering of the surface tension by two-dimensional liquids, vapours and gases does not, however, meet with universal acceptance, and we find the concept of a negative surface tension developed on the assumption of a molecular halo or wide zone of molecular attraction. This idea is based upon the view that a material spread upon the surface of water will cover but a definite area, and not expand indefinitely, as is assumed on the kinetic hypothesis, a problem clearly susceptible of experimental solution.

As is the case in solutions, the adsorption of ions at liquid interfaces is attended with the operation of electric forces resulting in an ordered distribution of the ions in the interfacial phase. The nature of this distribution is of great importance in an interpretation of the phenomena of electric endosmose and electric cataphoresis. Freundlich has shown quite definitely that the potential difference or electro-kinetic potential of which those phenomena are manifestations is in no way related to the total potential difference across the interface, the one considered by Nernst in his development of a mechanism of operation of electric cells. It is thus necessary to conceive an ionic distribution the total amount of which can be calculated by Gibbs' method, such as will give rise to those two well-defined potential differences. Whilst this problem still awaits a detailed solution, it appears clear that the old and well-known conception of Helmholtz of a condensed double layer, as well as the idea of a diffuse double layer developed by Gouy, must both be rejected in favour of some composite type combining the advantages of both.

Attempts have not been lacking to show that the free surface of a liquid presents an ordered arrangement. Whilst consideration of the mean life of a molecule on the surface of a liquid, as well as the dependence of the surface energy and the Eötvös constant on the molecular structure, show that some orientation does in fact exist, it is clear that the total surface energy of a liquid is not defined entirely by the nature and orientation of the surface layer of molecules.

The nature of the free surface of a solid and the phenomena attending adsorption are more complicated. Whilst unimolecular films are the rule rather than the exception on liquid surfaces, the building up of secondary films, *i.e.* multi-molecular in thickness, is quite frequent on solid surfaces, although the loss in free energy attending the formation of each molecular layer is greatest for the first layer. It is not, however, a simple matter to calculate the film thickness from the amount of material adsorbed, since the surface of a solid is by no means uniform in character, and breaks in the adsorption isotherm may indicate merely the covering up of a fresh portion of the surface possessing a different surface energy. The variation in surface texture, dependent upon the presence of different crystal facets and edges, as well as the presence of broken crystals, is accompanied by a variation in surface energy, the interrelationship for heteropolar materials having been investigated by Born and Lennard Jones. For metals, however, we are not yet in a position to make the necessary calculations. Whilst both catalytic activity and adsorptive powers are dependent on the nature of the surface, the almost specific nature of many of these processes shows that both surface energy and surface structure are necessary factors to be taken into consideration in dealing with these problems.

The Faraday Society is again to be congratulated in promoting a highly successful meeting, at which it was possible not only to listen to a number of distinguished foreign visitors, but also to obtain the point of view which has led different investigators in certain fields to diametrically opposed conclusions.

E. K. R.

The Wellcome Historical Medical Museum.

AFTER closure for nearly a year for reorganisation and enlargement, the Wellcome Historical Medical Museum, Wigmore Street, London, W.1, was reopened on October 14 by Sir Humphry Rolleston, in the unavoidable absence abroad of the founder, Mr. H. S. Wellcome. Sir Arthur Keith delivered a short address, and Sir Frederic Kenyon and Sir D'Arcy Power also spoke in proposing and seconding a vote of thanks to the previous speakers. A brief tour of the Museum discloses the great variety and interest of the collection, but does little more than whet the appetite for return visits on future occasions, when selected objects could be more fully studied.

The visitor first enters the Hall of Primitive Medicine, in which are displayed the paraphernalia of the medicine-man, including his masks and costumes; a reconstructed skull-hunter's hut from south-east New Guinea is here a prominent feature. In the same section are also arranged a large number of charms, amulets, and talismans used by both primitive and modern man. In the Anatomy Room the history of anatomy is illustrated by means of drawings, paintings, and sculpture: there is a fine collection of bone and ivory mannikins used in the teaching of anatomy in the sixteenth and seventeenth centuries. Proceeding through a short picture gallery, the visitor enters the Hall of Statuary, containing statues and casts of the deities associated with medicine in ancient times. In addition, the hall and its gallery contain collections of surgical, scientific, and dental instruments, arranged to illustrate the evolution of each particular instrument. Special mention may be made of the collection of microscopes and that illustrating the development of the modern spectacles.

One of the most interesting collections in the Museum is found at the end of the Portrait Gallery, where the Jenner relics are arranged: there one can see the original manuscripts in which Jenner's views on vaccination are set forth, and also the instruments used by him in his work; a homely touch is provided by the presence of his favourite arm-chair. Passing from the Alchemy Room, a flight of stairs is descended to the ground floor; the main hall contains a varied collection of pictures and material illustrating the War in both its naval and military aspects. At the far end is found the Lister Collection, including a portion of the actual Lister Ward from the Old Infirmary in Glasgow, in which he developed the practice of antisepsis in surgery. Passing sections illustrating methods of torture, the plague, and a lying-in room of the sixteenth century, the visitor enters a large hall devoted to the history of pharmacy. Here will be found a sixteenth-century alchemist's laboratory, a London chemist's shop of the eighteenth

century, a barber-surgeon's shop, and Chinese and Turkish drug stores.

Two impressions remained with us when we left: the great boon to mankind the discovery of anæsthetics has been, after inspection of the pictures illustrating surgical operations in pre-anæsthetic days, and the persistence of a belief in charms through many centuries up to the present day, in spite of the increase in scientific knowledge.

In the course of his address at the reopening of the Museum, Sir Arthur Keith said that a museum should fulfil two functions: it should serve the needs of students, fostering research, and at the same time it has a duty to the public, that of direct education. One way to write a history is by the study of the writings of others which have been preserved to us; the other is by the examination of the objects of man's handiwork, many of which have been retrieved through excavations, when their situation throws light on the periods at which they were in use: thus the existence of stone, bronze, and iron ages was discovered by this means. History, then, can be written on the shelves of a museum. But a history of medicine is the most difficult of all to write, since the use of a primitive medicine-man's emblems of his art is only really understood when we have a knowledge of his beliefs. On these he bases a theory of medicine, which guides him in the practice thereof; in general, the spirit is the real person and illness is due to the attack of baneful spirits, so that his practice is directed to the driving out of these immaterial beings.

A museum can only fulfil its main function of encouraging research if it is itself a centre of research. It can be seen when a museum is successfully fulfilling this function, by the appearance of members of its staff at scientific meetings, by the publications issuing from it, and by the number of students who make use of it.

In the education of the public the curator of a museum should be an able 'case-dresser.' The average man has little time or inclination for a detailed study of the exhibits, so that he requires his history to be put before him in a few well-chosen and salient objects Since the best elementary treatises are usually written by the most learned men, it is probable also that the educational function of a museum will be directed equally well with research by the most learned of our curators.

Money is an essential item in the work of a museum, so that the thanks of all are due to those who contribute service to mankind by founding and maintaining it as a centre of research and education.

University and Educational Intelligence.

CAMBRIDGE.—Mr. L. H. Thomas, Isaac Newton student and Smith's prizeman, has been elected to a fellowship at Trinity College. Mr. H. M. Robertson (Leeds) has been elected to a research studentship in economics at Emmanuel College, and Mr. A. H Wilson to an honorary research studentship in mathematics. The Hon. Bertrand Russell, Trinity College, will lecture on "The Analysis of Matter" at Trinity College, giving the Tarner lectures on the philosophy of the sciences.

Dr. A. C. Haddon, Christ's College, has been appointed honorary keeper of the New Guinea collections in the Museum of Archæology and Ethnology. J. A. Ratcliffe, Sidney Sussex College, has been elected to the Stokes Studentship for research in physics at Pembroke College.

The Commissioners have offered to the University for discussion new statutes modifying the statutes with regard to various trust emoluments to bring them into line with the new statutes. They propose a new statute, throwing open scholarships and prizes to women on the same terms as to men, leaving the University power to exclude women from any one or more of the emoluments for which they have not hitherto been eligible.

EDINBURGH.—Prof. E. Shearer, in his inaugural address as professor of agriculture, spoke on "Agricultural Education and the Community." He stated that our system of agricultural education is based on lines which are sound and well adapted to the general circumstances of the country. Useful work has been accomplished in the past, but present efficiency and future progress are unduly handicapped by meagre financial provision. Nothing is more certain than that the agricultural future, amidst ever-increasing competition, will lie with those nations that take the fullest advantage of scientific knowledge.

ST. ANDREWS.—The Court has appointed Dr. J. D. McBeath Ross to the lectureship in physical chemistry in University College, Dundee, vacant by the resignation of Dr. O. R. Howell, appointed to a post in Manchester Muncipal Technical College. Mr. J. M. Hay has been appointed to the lectureship in mechanical engineering and machine design in University College, Dundee, vacant by the resignation of Dr. W. J. Walker, appointed to the chair of mechanical engineering in the University of Witwatersrand, Johannesburg, South Africa.

ON Wednesday, October 20, H.R.H. the Prince of Wales opened a new women's hostel, a teaching dairy, and farm buildings at the Cheshire School of Agriculture, Reaseheath. These buildings complete the equipment of the institution, and render possible centralisation of a comprehensive scheme of agricultural education, hitherto somewhat scattered. The school lies in the centre of a small estate, the mansion on which serves as a residential hostel for forty men students and as the headquarters of a scientific staff. There are two farms, the larger, 210 acres in area, being used for teaching and commercial ends, and the smaller, which extends to 50 acres, being devoted to experimental work A 6-acre holding within the estate has been equipped as a poultry department, and the original gardens have been extended and stocked to illustrate various phases of horticultural work. An extensive range of stabling has been adapted as chemical, botanical, and bacteriological laboratories. The dairy, now added to the buildings, has been built primarily for teaching purposes; it has been equipped with the ordinary apparatus of a good cheese-making farm, and also with sufficient examples of dairy machinery to demonstrate the possibilities of mechanical devices. The Women's Hostel is a pleasing structure which perpetuates the half-timbered style so characteristic of the county. There is accommodation for thirty students. A county institution, the school aims primarily at instruction suited to the needs of farmers' sons and daughters, and others taking up rural pursuits for a livelihood. Separate courses, all of three to six months' duration, are provided in agriculture, dairying, horticulture, and poultry-keeping. Though the end in view is severely practical, instruction is largely on the traditional lines of scientific institutions; for it is characteristic of the Cheshire farmer that he wants his son to be taught "something he cannot learn at home," rather than to be trained in manual operations. The school also maintains an extensive advisory service throughout the county.

Contemporary Birthdays.

October 24, 1854. Right Hon. Sir Horace C. Plunkett, K.C.V.O., F.R.S.

October 26, 1874. Prof. T. M. Lowry, C.B.E., F.R.S.

October 27, 1856. Prof. Ernest William Hobson, F.R.S.

October 28, 1868. Mr. Frederick William Lanchester, F.R.S.

October 29, 1868. Mr. Charles P. Eugène Schneider.

Sir HORACE PLUNKETT, sometime an Irish administrator, was born in Gloucestershire. He was educated at Eton and University College, Oxford. Soon after attaining his majority he worked at the development of a ranch in Montana, acquainting himself with all the details of American agricultural methods. Afterwards, Irish agriculture and industry engaged his whole-hearted energies for many years, with much practical issue. Chairman of the (then) Sub-Section of Agriculture at the British Association's Dublin meeting in 1908, Sir Horace gave a highly informative address, worthy of reference to-day, on "Science and the Problem of Rural Life."

Prof. LOWRY was born at Low Moor, Yorkshire. Educated at Kingswood School, Bath, he entered later the Central Technical College of the City and Guilds Institute, South Kensington. Here for seventeen years, from 1896, he held an assistantship to Prof. H. E. Armstrong, F.R.S. From 1912 until 1916 he was lecturer in chemistry at Guy's Hospital Medical School. In 1920 Prof. Lowry was appointed to the chair of physical chemistry in the University of Cambridge. Bakerian lecturer of the Royal Society in 1921 (in collaboration with Dr. P. C. Austin), he dealt with "Optical Rotatory Dispersion." On the same subject he discoursed in December 1925, before the Société de Chémie Physique, Paris, in exemplification of Biot's researches. Prof. Lowry is the author of two useful works, "Historical Introduction to Chemistry" (1915) and "Inorganic Chemistry" (1922).

Prof. HOBSON, Sadleiran professor of pure mathematics in the University of Cambridge, was born at Derby. Entering Christ's College, Cambridge, he graduated senior wrangler. The Royal Society awarded him a Royal medal in 1907 in respect of the fundamental character of his contributions to mathematics and mathematical physics, particularly with reference to the history and development of mathematics.

Mr. F. W. LANCHESTER, whose pioneer work and researches in aeronautics were recognised last year by the Royal Aeronautical Society in the award of its gold medal, and by his election as an honorary fellow, was educated privately and at the Royal College of Science, South Kensington. Early in his career he was technical adviser to the Birmingham Small Arms Company, and to the Daimler Company. From 1909 until 1920 he was a valued member of the Advisory Committee for Aeronautics.

Mr. C. P. EUGÈNE SCHNEIDER, ironmaster and metallurgist, owner, in family succession, of the famous Creusot Works in France, was nominated in 1917 president of the Iron and Steel Institute, and he held office for a year. It was a departure in procedure cordially and unanimously received. Distinguished specially in metallurgical research and practice, Mr. Schneider is also prominent as a scientific industrialist. In 1920–21 the Iron and Steel Institute published papers of his in its *Journal* on "An Investigation of various Forging Operations carried out under Hydraulic Presses."

Societies and Academies.

LONDON.

Society of Public Analysts, October 6.—A. Chaston **Chapman**: On the presence of compounds of arsenic in marine crustaceans and shellfish. Marine crustaceans and shellfish have been found to contain from 10 to 174 parts of arsenic (as As_2O_3) per million of the wet edible portions. Native oysters contained from 5 to 10 parts, and Portuguese oysters from 33 to 70 parts per million. In fresh-water fish, shellfish and crustaceans, the amounts of arsenic ranged from only about 0·4 to 1·5 parts per million. The arsenic in the marine animals is therefore derived from the sea water. Potted and canned crustacea and shellfish contained from 0·5 to 85 parts of arsenic per million. The arsenic in the urine of two experimental subjects was raised from the normal figure of about 1/200 grain per gallon to ½ grain in one case, and ¼ grain in the other, after a meal of lobster.—A. Chaston **Chapman** and H. **Linden**: On the presence of lead and other metallic impurities in marine crustaceans and shellfish. The following amounts of copper (parts per million of the dried edible portion) were found: lobster, 167; crab, 130; and whelks, 115. The amounts of lead ranged from 5 (whelk) to 25·6 (lobster). Native oysters contained from 12 to 400 parts and Portuguese oysters 10 to 307 parts of lead per million. Like the arsenic, these metallic impurities are probably derived from the sea water.—A. R. **Tankard** and D. J. T. **Bagnall**: The examination of fish for formaldehyde. Various kinds of fish gave a positive reaction in Schryvor's phenylhydrazine test, indicating the presence of 1 to 2 parts per million of formaldehyde. Since, however, trimethylamine (a common constituent of fish) can be readily oxidised to formaldehyde, a positive reaction does not necessarily indicate the presence of added formaldehyde. The reaction tends to be less marked when putrefaction of the fish has set in.—Karl **Sandved**: The potentiometric titration of tin with potassium bromate. The best results (error 0·5 per cent.) were obtained by oxidation of the stannous tin with antimony chloride or ferric chloride, and potentiometric titration of the reduction compound with potassium bromate. A method of determining tin in the presence of antimony has been devised, and the potentiometric titration of ferrous iron has been closely studied.—R. R. T. **Young**: The determination of nicotine in tobacco. Kellor's, Kissling's, and other methods have been critically examined. Accurate results are obtained by extracting the tobacco with a mixture of petroleum spirit, ether, and aqueous potash, shaking the ethereal extract with dilute (1 : 1) alcohol containing cochineal, adding excess of hydrochloric acid to the separated aqueous layer, and titrating with standard sodium hydroxide. Ammonia is best determined by distillation after precipitation of the nicotine with iodine, but little ammonia, if any, was present in the tobaccos examined.

PARIS.

Academy of Sciences, September 6.—Alfred **Rosenblatt**: The plane irrotational movements of incompressible viscous fluids.—H. **Pélabon**: Rectifying contacts. A detector consists essentially of the system metal-dielectric-metal. The thickness of the dielectric must be as small as possible and remain constant. Various practical means of satisfying these conditions are suggested.

September 13.—H. **Deslandres**: Remarks on the law of distribution in time of magnetic storms. The theory of corpuscular radiation appears to be

able to explain the greater part of solar phenomena.—Valère **Glivenko**: Surfaces of finite area.—Julius **Wolff**: A generalisation of a theorem of Schwartz.—**Gossot** and **Liouville**: The principles of interior ballistics.—V. N. **Ipatief** and B. A. **Mouromtsef**: The reduction of chromic combinations by hydrogen under pressure and at high temperatures.—F. **Taradoire**: The rapid oxidation of drying oils and antioxygens. With the exception of the nitroso derivatives of diphenylamine, none of the other organic antioxygen substances employed were sufficiently active to prevent the spontaneous inflammation caused by the oxidation of drying oils on cotton wool.—**Raymond-Hamet**: A supposed sympathicotropism of Uzara.—Methodi **Popoff**, Minco **Dobreff**, and George **Paspaleff**: The development of the eggs of the sea-urchin (*Strongylocentrotus lividus*) under the action of extracts of the pollen of the oak and of calla.

September 20.—Th. **Got**: A remarkable class of ruled surfaces.—A. **Myller**: Normal curvature and geodesic torsion.—George D. **Birkhoff**: The signification of the canonical equations of dynamics.—André **Meyer**: The catalytic rôle of mercury in the sulphonation of anthraquinone. To explain the catalytic influence of mercury on this sulphonation, Martinet and Roux have formulated an ingenious hypothesis. One deduction from this is that α-anthraquinone sulphonic acid should be transposed into the β-acid by simple heating with concentrated sulphuric acid. This the author is unable to confirm, the α-acid remaining unchanged under these conditions.—E. **Kohn-Abrest** and S. **Kawakibi**: Nitrates in animal and vegetable tissues. Details of a modification of Lunge's method of determining nitrates suitable for organic material.

SYDNEY.

Royal Society of New South Wales, September 1.—F. W. **Booker**: The internal structures of the Pentamerinae of N.S. Wales. Brachiopod material was examined by means of serial thin sections, from 1 to 1.5 mm. apart. A new sub-genus, Barrandina (Synonym *Pentamerus linguifera*, var. *Wilkinsoni*, Eth. Fils 1892), containing two new species, *B. Wilkinsoni* and *B. Minor*, is described. A structure new to science is noted in the cruralium of these two species. It is also present in *Sieberella galeata*, Dalman, and *Sieberella glabra*, Mitchell, but not in *Pentamerella* (*Barrandella*) *Molongensis*, Mitchell.—M. B. **Welch**: The wood structure of certain eucalypts belonging chiefly to the ash group. The woods of seven species of eucalyptus are described in detail. In common with other members of the genus, the woods are practically diffuse-porous, though growth rings are more prominent in certain of these species than in most. The vessels possess simple end perforation. Transition forms occur between the fibre-tracheids, making up the bulk of the woody tissue, and the typical tracheids. Wood parenchyma is usually not abundant and is chiefly vasicentric.

Official Publications Received.

BRITISH AND COLONIAL.

Journal of the Indian Institute of Science. Vol. 9A, Part 2: Vegetable Oils containing Glycerides of Erucic Acid. By J. J. Sudborough, H. E. Watson and P. Ramaswami Ayyar. Pp. 25-70+2 plates. 2.8 rupees. Vol. 9A, Part 3: The Production of Ether by Solid Catalysts. By S. K. Kulkarni Jatkar and H. E. Watson. Pp. 71-100+4 plates. 3 rupees. Vol. 9A, Part 4: The Constituents of some Indian Essential Oils. Part 18: Derivatives of Abietic Acids. By Madyar Gopal Rau and John Lionel Simonsen. Pp. 111-116+3 plates. 8 annas. (Bangalore.)

Transactions of the Royal Society of Edinburgh. Vol. 54, Part 3, No. 17: Some new Ordovician and Silurian Fossils from Girvan. By Dr. F. R. Cowper Reed. Pp. 735-739+1 plate. 1s. Vol. 54, Part 3, No. 18: The Geology of Jan Mayen. By J. M. Wordie. Pp. 741-745+2 plates. 1s. 6d. Vol. 54, Part 3, No. 20: Calamoichthys calabaricus J. A. Smith. Part 1: The Alimentary and Respiratory Systems. By G. Leslie Purser. Pp. 767-784+1 plate. 2s. 6d. Vol. 54, Part 3, No. 21: Contributions to the Study of the Old Red Sandstone Flora of Scotland. iii: On Hostimella (Ptilophyton) Thomsoni, and its Inclusion in a new Genus, Milleria; iv: On a Specimen of Protolepidodendron from the Middle Old Red Sandstone of Caithness; v: On the Identification of the large 'Stems' in the Carmyllie Beds of the Lower Old Red Sandstone as Nematophyton. By Dr. W. H. Lang. Pp. 785-799+2 plates. 5s. 6d. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Department of Agriculture, Ceylon. Bulletin No. 76: Supplement No. 1 to the Guide to the Central Experiment Station, Peradeniya, issued as Bulletin No. 70. Pp. 24. (Peradeniya.) 40 cents.

Botanical Survey of South Africa. Memoir No. 7: The Native Timber Trees of the Springbok Flats. By Ernest E. Galpin. Pp. 26+26 plates. (Pretoria: Government Printing and Stationery Office.)

Department of Science and Agriculture, Jamaica. Microbiological Circular No. 5: Panama Disease in Jamaica. By C. G. Hansford. Pp. ii+35. (Kingston, Jamaica: Government Printing Office.)

University of London: University College. Calendar, Session 1926–1927 (Centenary Year). Pp. clxxx+10+475+44. (London: Taylor and Francis.)

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 64, No. 358, October. Pp. 989-1092+xxx. (London: E. and F. N. Spon, Ltd.) 10s. 6d.

Engineering Abstracts from the Current Periodical Literature of Engineering and Applied Science, published outside the United Kingdom. Published by the Institution of Civil Engineers with the Co-operation of other Engineering Societies in Great Britain and the Dominions. New Series, No. 29, October. Pp. 221. (London: The Institution of Civil Engineers.)

FOREIGN.

Transactions of the Astronomical Observatory of Yale University. Vol. 3, Part 4: Catalogue of 1275 Stars; Re-observation by Means of Photography of Astronomische Gesellschaft Stars between Declinations +1° and +2°, reduced to 1875·0 without applying Proper Motions. By Frank Schlesinger, with the collaboration of O. J. Hudson, Louise Jenkins and Ida Barney. Pp. 135-151. Vol. 3, Part 5: Complement to the Tables of the Motion of the Moon, containing the Remainder Terms for the Century 1800-1900, and Errata in the Tables. By Ernest W. Brown, with the assistance of H. B. Hedrick. Pp. 155-204. Vol. 3, Part 6: The Evidence for Changes in the Rate of Rotation of the Earth and their Geophysical Consequences, with a Summary and Discussion of the Deviations of the Moon and Sun from their Gravitational Orbits. By Ernest W. Brown. Pp. 205-235+3 plates. (New Haven, Conn.)

Department of Commerce: Bureau of Standards. Scientific Papers of the Bureau of Standards, No. 530: Establishment of Radio Standards of Frequency by the Use of a Harmonic Amplifier. By C. B. Jolliffe and Grace Hazen. Pp. 177-189. (Washington, D.C.: Government Printing Office.) 10 cents.

Rapport annuel sur l'état de l'Observatoire de Paris pour l'année 1925, présenté au conseil dans sa séance du 6 mars 1926. Pp. 26. (Paris.)

Cornell University Agricultural Experiment Station. Bulletin 449: Biology and Control of the White-Pine Weevil, *Pissodes strobi* Peck. By Samuel A. Graham. Pp. 32. Memoir 97: Calcium Sulfate as a Soil Amendment. By M. H. Cubbon. Pp. 51. (Ithaca, N.Y.)

Jahresbericht der Hamburger Sternwarte in Bergedorf für das Jahr 1925. Nebst einer Übersicht über die meteorologischen Beobachtungen 1919–1925. Pp. 34. (Bergedorf.)

Astronomische Abhandlungen der Hamburger Sternwarte in Bergedorf. Band 2, Nr. 7: Beiträge zur physischen Untersuchung der grossen Planeten. 3: Beobachtungen und Zeichnungen des Planeten Mars während der Periheolopposition 1924 ausgeführt am 60 cm-Refraktor der Hamburger Sternwarte in Bergedorf. Von K. Graff. Pp. 30+12 Tafeln. (Bergedorf.)

Mitsuru Kuhara's On the Beckmann Rearrangement. Edited by Prof. Shigeru Komatsu. Pp. v+83. (Kyoto: Kyoto Imperial University.)

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Publication No. 587: A Decade of Progress in the Design and Manufacture of Scientific Optical Instruments and Apparatus. Pp. 20. (York and London: Cooke, Troughton and Simms, Ltd.)

Price List for 1926-7. Pp. 28. (London: Dubilier Condenser Co., (1925) Ltd.)

Microscopical Illuminating Apparatus. Pp. 32. (London: Ogilvy and Co.)

transplanting our laws, our customs, our institutions, our processes, among alien peoples and on alien soil, we should take heed lest we destroy much that is intrinsically valuable. We cannot legislate for every section of humanity as if it were cast in the same mould.

There are tremendous responsibilities implied in our trusteeship of the African native. Our duty to him and to the world does not end by making him a more efficient instrument for the development of the natural resources of his country. We have to safeguard him against the evils arising from a catastrophically sudden contact with our so-called modern civilisation. Our aim should not be to evolve Europeanised Africans, but to enable Africans to build up their own civilisation based upon all that is best in their culture and traditions.

The task confronting our administrators demands much patience, much tact, and a ripe understanding based upon knowledge born of intensive study of the peoples. We cannot afford to send out our administrators like "little children stumbling in the dark." They must be equipped for their task lest they destroy faster than they build. There is now a wealth of accumulated experience and knowledge at our command in our schools of anthropology. It is this which Mr. Ormsby-Gore wishes to enlist in the service of the British administration in tropical Africa.

"If we are to succeed in our duties towards these peoples as rulers or as missionaries, or as instruments for their advance or civilisation, we must study them objectively and base our policy on real understanding acquired not only from personal contact, but from scientific study of their mental and moral characteristics, of native law and customs, of native history, language and traditions. Native methods of agriculture, native arts and crafts, should be examined scientifically before any attempt is made to supersede what we find existing."

The above quotation is a prelude to a delightful chapter on the indigenous population. The rest of the report is dull in comparison. In the small compass of twelve pages are summarised the results of much reading and still more careful observation. In them is to be found more information most attractively presented of the West African natives, their traditional forms of government, their languages, their forms of religion, their special characteristics, than it is usual to find in several volumes. It is almost Wellsian in style. With zest the author repeats the description by a Mohammedan ruler in Northern Nigeria of an English court of law as a place where "two professional liars appear to prevent the judge from ascertaining the truth." If this is the usual conception held of our legal system by Mohammedans, it is obvious that any attempt to supersede theirs, where judicial and executive functions are combined, would lead to considerable friction.

While the East African tribes have so far no aptitude for trading, and consequently are at the mercy of Indian, Arab, and Syrian middlemen, the West Africans have in their midst a negro tribe, the Hausas, who carry on itinerant trading and have created trading centres throughout Nigeria and the Gold Coast. The Yorubas, another negro tribe, have solved the problem of town-dwelling in a way which should commend itself to our own city-dwellers. They are both farmers and townsmen. They live in great towns—Ibadan contains 250,000 people—and go out daily to cultivate their holdings, some so far as ten to twelve miles from the city. None would interfere with his neighbour's crops. They are as sacrosanct as the fruit of the apple trees planted by German municipalities along their main roads.

Just as in East Africa, in the mountain fastnesses, there are remnants of tribes like the Wachagga and the Bagishu scattered among the Bantu and the Nilotic races, so in West Africa there are remnants of the Bauchi tribe, a primitive pagan people - still, it is alleged, addicted to cannibalism—scattered among the virile and intelligent Moslem tribes of Northern Nigeria. The Bauchi have protected themselves against attack by building heavy stockades hedged with the poisonous euphorbia shrub and cactus, and the use of poisoned arrows. They live in isolated communities, each of which has its own dialect, and are not yet accustomed to wearing clothes. Of the Ashantis we are told that they are organised in a quasi-feudal system, and even their land system is strikingly parallel to that which obtained in Britain in medieval times. The king himself, the Omanhene, has not only a council of barons to advise him, and if they consider necessary, to dethrone him, but also his position is rendered more delicate by a council of women headed by the Queen-Mother, who, being elected to the office, exercises parental authority without necessarily having had the responsibility of giving birth to the king. She is almost invariably a political power to be reckoned with.

The existence of an English-speaking African population raises special problems both in their relations with government and with the vast mass of their fellow Africans in the interior. They have sprung up through long contact with European traders on the coast, and by the creation of settlements for freed slaves from the Americas. Unlike the French, who encourage it, we definitely dislike the assimilation of our culture, our outlook, and our social habits by people of a different race; the nearer they approximate to us in these respects the wider becomes the gulf between them and us. Mr. Ormsby-Gore states the problem, but he gives

no indication of a definite policy to be pursued, contenting himself with saying that the relations between the races must be based on mutual respect and understanding. It would be well if we faced the fact that the natives are rapidly becoming suspicious of the motives underlying the social exclusiveness of the English-speaking whites. It is notorious that many of the natives in Northern Rhodesia are forsaking British territory for work in the Belgian Congo, preferring the absence of racial discrimination among the Latin whites to the comparative freedom they enjoy under British rule. We cannot afford to be content with the expression of pious sentiments regarding mutual respect and understanding. We must have a definite policy, one that is intelligible and does not affront the intelligence of the better educated natives, who are capable of exercising considerable sway over their fellow-tribesmen: otherwise we shall create an ever-widening gulf between ourselves and the black races which can never be bridged.

British policy with regard to the administration of the native races has its parallel in the policy of the average captain of industry in a European industrialised state towards the workers in industry. Every material inducement is offered to enable the workers to produce more and to produce better in order that they may live fuller, more contented lives, yet one thing is lacking: neither rulers abroad nor rulers in industry at home are prepared to share the control which they monopolise; and in denying the peoples concerned a progressive share in the control of the machinery of government or of industry, they are wounding their self-esteem and progressively widening the breach between races and between classes.

So far in Africa, Great Britain has not determined to share the highest authority with members of the subject races. We are prepared to delegate authority; we are perpared to permit and even to bolster up a system of indirect rule under our supreme authority; we are not prepared to relinquish control for guidance. Whatever benefits we may have bestowed upon the Africans, therefore, will be regarded by them as being actuated by no higher motive than self-interest or as more subtle means devised for their exploitation. Every new road, every new railway, every new plant-product introduced, every new process, however necessary they may be if the potential resources of these vast territories are to be developed, increases the complexity of the African's life and sounds the death-knell of many of his institutions, habits, and customs. His needs increase and he has to work harder than ever. The transitory delight in the new gives way rapidly to an infinite regret for the loss of the old. Discontent is the parent of suspicion, and the suspicion can only be allayed by fitting him for the assumption of full responsibility.

Education is the only means by which the natives can be fitted to assume responsibility and adjust themselves deliberately to their special environment, and to adjust the environment itself to the changing conditions brought about by impact with the modern world. Mr. Ormsby-Gore has an abiding faith in the efficacy of education as an instrument of progress. He realises that in West Africa at least there is no possibility of creating an English colony. The personnel of the technical services, therefore, must be largely in the hands of the natives themselves, who look to the Europeans for guidance only in the initial stages of development. The chief needs of the country are education services which must supply well-trained natives for medical, sanitary, veterinary, agricultural, and other technical services. They will also have to meet the growing demand for native administrators. The basis of all education must be the primary school system, and it will be the greatest mistake to limit the provision of education to the favoured few. Mr. Ormsby-Gore is probably right in condemning a large number of the small bush schools which flourish throughout the territories, but it would seem to be a mistaken policy to close down any type of school catering for the native communities and selected by themselves for the satisfaction of their appetite for education, before the governments are in a position to satisfy the needs of the natives by the adequate provision of better schools. Our motives in suppressing the one without creating another to take its place would not be understood.

Mr. Ormsby-Gore's picture of the standard of teaching in the schools in West Africa makes somewhat depressing reading, and is certainly a reflection upon the capacity of the administration, the directors of education, and the missionaries. Where any system exists, education has been subordinated to the task of cramming African children for the Oxford and Cambridge junior and senior local examinations and the University of Durham pass degree. The majority of text-books in use in the various schools he considers to be unsuitable. Some of the elementary English reading books in use have been long obsolete in Great Britain. In respect of text-books and readers the schools in West Africa under British administration fall far short of those in use in the neighbouring French colony. Children had a parrot-like knowledge of the names of places in England, but no knowledge at all of the geography of West Africa. Many of the books used dealt with words and objects entirely outside the experience of the African children.

It is evident from the description of what purports to be an education system in West Africa, that education has been entrusted to people without any conception of

the true purpose of education or any ideas of modern educational methods. Much is hoped for from the newly created Prince of Wales College at Achimota in the Gold Coast Colony, but it is evident that profound changes will have to be made in the personnel of the advisory committees on education and the education staffs themselves if any effective progress is to be made. What is needed are directors of education and staffs who are professionally trained to be alive to the potentialities of education, to the paramount need for elasticity in the treatment of educational problems, to the importance of psychology as a factor in educational training, and to the need for continuous experiment and research in educational method. With ignorance at the helm, education degenerates into mere instruction, its aim is confined to fitting persons for predetermined tasks, and the wider aim is unfulfilled of fitting them to live fully and to accept the responsibilities of citizenship, the basis of which is ungrudging service to the community. Mr. Ormsby-Gore is disappointingly silent on this aspect of education.

Cotton and Food.

The Cotton-Growing Countries, Present and Potential: Production, Trade, Consumption. International Institute of Agriculture, Rome. Pp. xxxvi + 317. (London: P. S. King and Son, Ltd., 1926.) 12s. 6d. net.

STUDENTS of the cotton industry were placed under a lasting obligation to the author of "The World's Cotton Crops" when it was published in 1915, and a grasp of the subject thus became available to any reader. The details of cotton-growing interests collected in that book gave internal evidence of the labour required to make an effective compilation by single handed effort; the form of the book gave a reality and unity to the subject which a bald compilation must lack. It was too much to expect that Prof. Todd would be able to keep his book up-to-date, so that the action of the International Institute of Agriculture in producing the memoir now before us is doubly welcome, both as an authoritative statement of facts and as a supplementary volume to be shelved for reference beside "The World's Cotton Crops."

The present memoir amplifies an earlier publication on the same subject which the Institute issued in 1922. As its title indicates, the fact of a small production does not exclude a country from its pages, so that unexpected information can be derived from them; several acres of cotton grown successfully near Budapest in 1924 may be cited. It is not the function of such a compilation to balance critically the information derived from one country against that from another; this must be left to those who use the facts provided, in which they are assisted by a useful foreword. Such users will be well advised to bear this limitation of function in mind, for in many countries the full potentiality can never be made commercially effective, on account of such restrictions as are imposed by unevenly distributed rainfall, by the area available for irrigation, or by the irrigation available for the area.

The information given for eighty-one geographical localities, including the United States and Liberia, Egypt and Fiji, India and Barbados, is arranged to show so far as practicable the authorities quoted, data of area and crop, local geography and chronology of the crop, botanical and entomological information, together with merchanting particulars, including local manufactures.

Returning from the details which are the chief constituent of this volume, we may with advantage look more carefully at the interesting foreword. Amongst other things to which it directs attention is the stimulus given to cotton growing of late years by the high prices which resulted from short crops in the United States; this stimulus is very evident in some of the tables, where new countries continually appear from 1922 to 1925. It also directs attention to the probability of a continued fall in price from those stimulating levels, and to the consequent repetition of that vicious circling movement so familiar in cotton supply and demand. The foreword leaves the topic at this stage, for it is by such presentation and discussion of facts as this memoir provides that the radius of the vicious circle may be contracted. It is, nevertheless, quite possible that the ostensible circle is in reality part of a spiral, and that the whole cotton industry is entering upon a transition phase, from which it will emerge as a smaller and more highly specialised producer of high quality goods. The years during which short-time working has lately been practised may not be ephemeral, and the fact of such prolonged short time may not be a mere incidental consequence of post-War disturbances; it may be part of a coming shrinkage. While the significance of the artificial fibres as a cause which has begun to contribute to such shrinkage may be open to discussion, there can be little question that the supply of cotton will very soon be liable to direct competition through the rivalry of food crops.

The world's food demands were brought to the notice of the public by Sir Daniel Hall's recent address at the British Association, and there is an admitted probability that these demands will equate to the available known resources within a few generations; the situation will rectify itself, of course, by moving

in the same vicious circle of demand and supply as obtains with cotton, but at the cost of some inconvenience to the world, unless it is anticipated. Such anticipation is not merely a problem for the dim and distant future; indeed, Prof. E. M. East has ventured to date the impact to happen within the life of potential centenarians already born. But long before this date is reached there will be a shouldering-out movement, wherein the textile plant will have to get off the arable earth, unless it can show itself to be irreplaceable by synthetic or forest products.

Another phenomenon which may perhaps be symptomatic of the same process in the making is also mentioned in the foreword. The design of the cord tyre for motor-cars gave the durability of the best cotton an opportunity to assert itself, which the chances of accidental damage had obscured in the old fabric tyre; the tyre-maker's demand for Sakel cotton, still more for Sea Island, outran the supply available at a competitive price, and many tyres are now made to wear well enough with lower quality cotton. But those who combine some knowledge of cotton with an interest in the autocar will be well aware that one firm which persisted in using Sakel won itself enviable reputation. Again the solution seems to lie in specialisation towards producing more good cotton, even if less of ordinary cotton.

We notice that the foreword makes one frank statement of ignorance which it is refreshing to meet. "Quality, in cotton, is a very vague term, and cannot be conveniently or tersely expressed, except in terms of the market price." Though this statement may appear surprising, it is quite true, and the absence of any analytical comprehension of 'quality' has been such a drag on the possible usefulness of botanists and plant breeders to the industry as must have been experienced to be appreciated. The late Mr. J. W. McConnel realised this, and initiated research work on the subject some twelve years ago; a book which summarises our broad conclusions is now in course of preparation, while the fuller details are being patiently dissected out in various textile research institutions. It may be hoped, therefore, that when the next issue of this memoir appears, the editor will be in a position to excise the statement we have quoted, and to extend his useful analysis of the general position accordingly.

The text is commendably free from misprints ("*Neocosmospera vas infecta*" is noted on p. 11), which carries the presumption that the tabulated data are equally correct. Thus, for reasons already given, and for its citation of authorities, this volume should be within reach of all who are interested in cotton supplies, whether industrially or scientifically.

W. LAWRENCE BALLS.

Modern Aspects of Evolution.

Nomogenesis: or Evolution determined by Law. By Prof. Leo S. Berg. Translated from the Russian by J. N. Rostovtsow. Pp. xviii + 477. (London: Constable and Co., Ltd., 1926.) 28*s.* net.

THIS volume represents the mature thought of an accomplished ichthyologist and traveller who speaks from the point of view of a naturalist and field observer and marshals, in the first nine chapters, all the difficulties that have arisen through field observation in the original concept of Darwinism. The title "Nomogenesis" signifies "evolution determined by law" rather than by selection from the accidents of variation. In the opinion of the author and in the language of Prof. D'Arcy Thompson, who writes the introduction, "No place is left for Chance in the manifestation of new characters; the course of evolution is fixed and determined. The same laws are at work in the growth of the individual as operated with like results in former generations; and what we call 'recapitulation' means nothing more."

In the work before us, all the arguments against selection are cited from the works of a list of authors which fairly cover the whole field of literature from Darwin to the present time. A very fair statement is made of the arguments of prominent selectionists, like Poulton and Plate, of the new direction of the selection hypothesis in the work of mutationists, as well as of comparable results reached by palæontologists such as Abel, Dollo, and Osborn. But a large and more valuable part of the work and of the literature cited is that pertaining to field observations of naturalists working in every branch of zoology and botany.

The author's general attitude toward the selection theory is a reaction which, in the reviewer's opinion, carries him much too far in the opposite direction: in endeavouring to undermine the whole doctrine of the selection of chance variations, he undermines the broad selection principle as well, and thereby loses all touch with what may be called the larger concept of Darwin and of Wallace, namely, that evolution is constantly guided and directed by "the preservation of favored races in the struggle for life." Nor is any serious attempt made by the author to formulate the coefficients of living forces which are observed to combine in the formation of new sub-species and species. In this aspect the author is facing what we are all obliged to face—complete ignorance of the underlying causes of the origin of the new adaptations and new species which he sums up in the word 'nomogenesis.'

Prof. Berg is naturally strongest in his own field, namely, in his observations on the geographical

variations of the fresh-water fishes of Europe, among which he notes the following curious circumstance:

"As we move further south the number of species and varieties of fishes, as of other animals, increases. But, at the same time, it becomes evident that variations in genera very widely separated often exhibit a tendency to develop *in one direction*. Thus, in the South European and Caucasian species of Chondrostoma (of the Cyprinidæ), we observe a decrease in the number of the rays of the dorsal and anal fins as compared with what occurs in the North European and Russian representatives of that genus: in the North European *Chondrostoma nasus* the dorsal fin usually contains 9 branched rays, and the anal 10-11; in the numerous South European species of the same group there are generally 8-9 branched rays in the dorsal fin, while the number of those rays in the anal falls to 9. Such a decrease in the number of rays is still more pronounced in the South European and Caucasian species, which are grouped about *Chondrostoma toxostoma*: the number of rays in the dorsal and anal fins has in both cases decreased to 7."

Prof. Berg observes a similar diminution of fish rays in other genera of the carp family (Cyprinidae), namely, in bleaks, chubs, and roaches, which are also distinguished as one travels southward by a diminished number of scales, of fin rays, and of vertebræ, and by an abbreviation of the body. He extends this comparison very widely with similar observations by Günther, Jordan, and other ichthyologists, and concludes (p. 268) that "it is highly improbable, and indeed quite incredible, that in all the species named, belonging to separate genera, variations, which have led to the same results in all the species, should have arisen *by chance*."

In Chap. x., "The Formation of New Species," the author extends his comparison to the gudgeon (*Gobio gobio*), and gives his final opinion as follows:

"*In the origination of new geographical forms* (species, sub-species, nationes) *a vast number of individuals inhabiting a certain geographical area are simultaneously involved in the production of new characters*. . . . The trend towards the development of scales on the throat, united with a combination of other characters, is something *primary, occurring in accordance with some law throughout the entire area of distribution of the southern gudgeon*."

A novel, but we believe thoroughly sound, application of the same directive principle in evolution to new verbal forms in languages is illustrated by Russian and French examples, with the following conclusion by the author:

"In my opinion, the above-mentioned variations of language are determined by modifications in the organs of speech, *i.e.* possess an anatomical basis. These phenomena, consequently, enter into the domain of the naturalist: they are fully homologous to the new formations to which the various forms of organisms have been subject in time (geologically) and in space (geographically)."

Although the reviewer is unable to agree with many of the points of view of the author and to accept the complete antithesis presented (p. 406) between Darwin's conceptions and his own, this volume is welcomed as a thoughtful and, in large part, original contribution to the newer modern aspect of the evolution theory.

HENRY FAIRFIELD OSBORN.

Mind and Matter.

The "Margery" Case. By E. J. Dingwall. *Proceedings of the Society for Psychical Research.* Vol. 36, Part 98. June 1926. Pp. 79-170. (London: Francis Edwards, 1926.) 6*s*. net.

ONE of the best arguments for the utility of a Society for Psychical Research is furnished by a case of apparently well-authenticated telekinesis and 'materialisation' such as that of the medium known in the United States as 'Margery,' the wife of a highly qualified Boston surgeon.

The test was undertaken by the Society's research officer, Mr. E. J. Dingwall, and its course and result are closely analogous to the case of the 'Goligher Circle,' investigated after the death of Dr. W. J. Crawford. In both cases the investigator was prejudiced in favour of the authenticity of the phenomena and their 'supernormal' character, but was gradually forced to the opposite conclusion by the consistent failure of every attempt to render the phenomena evidential.

As in the case of Crawford's experiments, the proceedings are controlled by an 'operator,' purporting in this case to be the medium's deceased brother Walter, whose direct voice, apparently independent of the sitters, is heard in the room. The voice prophesies or promises the physical phenomenon, and then, under test conditions, it often happens as stated. But when pressed by suggestions which are distasteful to him, Walter either makes promises which are never fulfilled, or turns the thing into a joke with a series of droll witticisms, at which he is both skilled and highly amusing.

Control was made difficult from the beginning by the stipulation that the medium's husband should have free access to the sittings and should control one of the medium's hands. But Mr. Dingwall thought it best to let the phenomena develop along their own lines in the first instance and to tighten up the control later. He was rewarded by some very remarkable manifestations, including the ringing of an enclosed bell constructed by the *Scientific American* Committee. This was done in a red light, but was preceded by an 'incubation' period of darkness.

The record of the sittings shows a steady development which appeared to justify the waiting attitude adopted by the investigator. In the course of the ninth sitting (January 9, 1925) a self-luminous cardboard was introduced, and what appeared to be a mass of teleplasm was thrown upon it and underwent certain changes of shape as promised by Walter. One, two, three, four, or five fingers of all shapes were made to grow out from the mass, some slowly, some quickly; then a short coarse thumb, and finally one long projection with a hook on it, in all twelve inches long. Meanwhile Walter kept up almost continual conversation mixed with his characteristic laugh, all heard in between the medium's obvious snores.

A suggestion made by Mr. Dingwall to employ a gauze cage in order to prevent manipulation by the medium was refused, but as a compensation Walter promised to show a materialised head upon the medium's shoulder, and eventually to show the appearance and disappearance of the teleplastic substance from the body of the medium. From what he said it was clear that the extrusion of the substance would resemble a normal birth, as indeed it has been alleged in the case of other mediums. Walter stipulated that a flat piece of wood should be provided projecting in front of the medium's chair in order to support the substance on its emergence. Mr. Dingwall remarks that this proviso is inconsistent with the supposed vitality of the substance. At the twenty-fifth sitting some excellent photographs were taken, and in the course of intermittent illuminations with red light an object was seen on the table resembling a very aged hand. Walter said, "This mass is really blood, the white corpuscles. When it goes back it strikes the heat and dissolves" Mr. Dingwall obtained permission to raise the object from the table. It resembled in shape a hand, but appeared to be a light skinny bag weighing two or three ounces. The medium turned in her chair and the object was pulled out of his hand, crumpling up in the process.

The attempts to show the growth and disappearance of the substance had no evidential value, since a few glimpses of the substance, separated by dark intervals, were only allowed to show successive stages

Summing up his impressions, Mr. Dingwall says: "The one fact which stands out in favour of the hypothesis of genuineness is undoubtedly the personality and position of Margery and her husband, and the improbability of their engaging in persistent trickery." On the other hand, he considers it possible that a surgeon of rationalistic tendencies might experiment on the gullibility of a presumably expert investigator with the view of its eventual exposure.

The interest of this case lies in the fact that it constitutes, in Mr. Dingwall's opinion, the most advanced example of alleged telekinesis and teleplastics ever investigated by the Society. It is quite arguable that any phenomenon the occurrence of which depends upon the whim of a disembodied entity whose behaviour escapes the application of all human standards is *ipso facto* outside the pale of science; and it is a matter of history that the progress of science has coincided with the elimination of such factors. On this planet, at all events, the controlling mind is the embodied mind of man, and to admit any other to a position of superiority, or even equality, involves the abdication of science.

It is all the more important that alleged phenomena of a 'supernormal' character should be subjected to sympathetic, critical, and competent investigation, and of such investigation Mr. Dingwall's report is a good example.

The Hon. Everard Feilding appends a well-written review of the adverse Hoagland Report on the same medium published in the *Atlantic Monthly* on behalf of a committee of Harvard graduates. He does not regard this highly controversial matter as by any means finally settled. E. E. F. D'A.

Our Bookshelf.

Sarajevo: a Study in the Origins of the Great War. By Dr. R. W. Seton-Watson. Pp. 303. (London: Hutchinson and Co., Ltd., n.d.) 18s. net.

This important book appears at a very opportune moment. A vigorous and characteristically thorough movement has been going on for some time in Germany, to shift the responsibility for the War from German shoulders, and land it on those of the allies, and in the first place of Russia. Quite recently, the movement has taken hold of a large section of the historians of the United States under the lead of Prof. Barnes, who has been lecturing with great acceptance in Berlin this summer on these lines. They call themselves the 'Revisionist' School, and Prof. Barnes's book is now expected in Great Britain, if indeed it has not already arrived. Now, just before we get it, Dr. Seton-Watson gives us in this compact and well-documented volume an authoritative account of the whole thing from the most important point of view, that is, the relations between the Southern Slavs centred in Serbia and the Austrian Government under Francis Joseph. This was the point of ignition, and the crime of Sarajevo was the spark.

Dr. Seton-Watson has made a life study of the whole Slav question, and his account is obviously impartial and as exhaustive as the published documents permit. These are unusually numerous and full, as the new Succession States have naturally published everything they could. The result is astounding but unquestionable. The assault on Serbia was deliberately engineered with determination, unexampled duplicity, and a complete recklessness of the consequences, by the war

party in Vienna, and above all by the Chancellor Berchtold, who, having secured a free hand from Germany, managed gradually, and in the end by a falsehood, to win over the old Emperor to the declaration of war.

The only satisfaction one can derive from the terrible story is that those have paid most heavily who sinned worst. The old Austrian system which produced such things has been completely swept away—the best and greatest clearance of the War. F. S. MARVIN.

The Natural History of Wicken Fen. Edited by Prof. J. Stanley Gardiner. Part 3. Pp. 173-266. (Cambridge: Bowes and Bowes, 1926.) 5s. net.

THE acquisition of Wicken Fen by the National Trust has afforded Prof. Stanley Gardiner and his colleagues an opportunity of carrying out a type of natural history investigation which British zoologists have been inclined to neglect, although it promises valuable results. In the British Isles, collecting has tended to diffuseness: the entomologist flits from one area to another where good collections are likely to be made; other local lists owe their existence to the chance presence of enthusiasts, but seldom is a single limited area worked to the bone as regards all its content. Part 3 of the "Natural History of Wicken Fen" continues the results of the intensive study of natural groups, ranging from Oligochæta and Mollusca to several insect orders, and including a flora list and a historical note on changes in the fen during the last forty years, all valuable contributions.

The biological aspect is notably prominent in the papers by Prof. Balfour-Browne, Miss Pickford, and Mr. Hutchinson, and a perfect foundation is being laid for an ecological study which will trace the fluctuations of the animal groups in relation to each other and to the vegetational and soil changes from season to season and from year to year. Zoology has lagged far behind botany in ecological study, but we trust that before this series is completed, the editor may be able to arrange a symposium which will make up some of the leeway. J. R.

Naturforscher und Erfinder: Biographische Miniaturen. Von Prof. Dr. Ludwig Darmstaedter. Pp. vii+182+16 Tafeln. (Bielefeld und Leipzig: Velhagen und Klasing, 1926.) n.p.

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Or les travaux antérieurs de Chree sur la succession de ces orages (*Phil Trans*, 1912, A, vol 112, p. 78, et 1913, vol 213, p. 245) font bien ressortir leur tendance à revenir à des intervalles qui sont des multiples de la période T, mais non d'une période plus petite. Aussi le Dr. Chree, sans condamner absolument mes résultats, émet des doutes sur leur validité

Je suis conduit à présenter quelques remarques sur les recherches de Chree et les miennes Je montrerai brièvement que les méthodes employées par les deux auteurs sont très différentes, et que les résultats obtenus pouvent ne pas être exactement les mêmes

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D'autre part, l'Observatoire de Meudon que je dirige, et qui est consacré spécialement à l'étude du soleil, enregistre depuis 1922 la déclinaison magnétique sur un papier sensible qui noircit sans développement et est placé dans la salle même de notre grand spectrohéliographe L'observateur du soleil peut, en soulevant un simple voile, avoir sous les yeux la courbe magnétique des 48 dernières heures, et il est prévenu par une sonnerie, lorsque la perturbation est forte. Le papier se déroule avec une faible vitesse (40^{mm} en 24 heures) et est relevé seulement toutes les semaines. L'appareil est surtout avertisseur, et il enregistre toutes les variations un peu notables, en assurant leur comparaison très facile

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Størmer a mis récemment hors de doute que les aurores et les orages magnétiques sont dus à un rayonnement corpusculaire émané du soleil et formé le plus souvent de particules négatives. Les points de forte émission corpusculaire, qui, dans le soleil, sont de véritables volcans, ont donc une distribution régulière ; ils occupent des méridiens dont les différences en longitude sont des multiples de 60°, 30°, et 15° Comme cette division spéciale est celle des corps à symétrie circulaire qui se refroidissent, les faits précédents conduisent à admettre, tous les onze ans, des brisures régulières dans trois couches solaires, qui, placées sous la surface, rejettent au dehors par intermittences leur matière fortement ionisée ou radioactive. Ils conduisent aussi à une explication simple des variations undécennales du soleil (voir les mémoires originaux).

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party in Vienna, and above all by the Chancellor Berchtold, who, having secured a free hand from Germany, managed gradually, and in the end by a falsehood, to win over the old Emperor to the declaration of war.

The only satisfaction one can derive from the terrible story is that those have paid most heavily who sinned worst. The old Austrian system which produced such things has been completely swept away—the best and greatest clearance of the War. F. S. MARVIN.

The Natural History of Wicken Fen. Edited by Prof. J. Stanley Gardiner. Part 3. Pp. 173-266. (Cambridge: Bowes and Bowes, 1926.) 5s. net.

THE acquisition of Wicken Fen by the National Trust has afforded Prof. Stanley Gardiner and his colleagues an opportunity of carrying out a type of natural history investigation which British zoologists have been inclined to neglect, although it promises valuable results. In the British Isles, collecting has tended to diffuseness: the entomologist flits from one area to another where good collections are likely to be made; other local lists owe their existence to the chance presence of enthusiasts, but seldom is a single limited area worked to the bone as regards all its content. Part 3 of the "Natural History of Wicken Fen" continues the results of the intensive study of natural groups, ranging from Oligochæta and Mollusca to several insect orders, and including a flora list and a historical note on changes in the fen during the last forty years, all valuable contributions.

The biological aspect is notably prominent in the papers by Prof. Balfour Browne, Miss Pickford, and Mr. Hutchinson, and a perfect foundation is being laid for an ecological study which will trace the fluctuations of the animal groups in relation to each other and to the vegetational and soil changes from season to season and from year to year. Zoology has lagged far behind botany in ecological study, but we trust that before this series is completed, the editor may be able to arrange a symposium which will make up some of the leeway. J. R.

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On distingue les deux séries à intervalles de 60° et de 30°. A noter que la deuxième série n'occupe pas

exactement les intervalles de la première ; les orages nous arrivent avec un certain retard, ce qui peut tenir à la vitesse plus faible des particules (voir le mémoire original).

Les orages ordinaires non S de 1925–1926, plus nombreux que les orages S, rentrent aussi dans la loi précédente ; ils sont représentés par leur pointe la plus élevée, la variation diurne de l'aiguille étant défalquée. Parfois on hésite pour décider si un orage est S ou non S, ou hésite entre deux longitudes ; mais le cas est rare et il arrive que les deux longitudes peuvent se rattacher à la loi qui est seulement approchée.

Enfin, fait curieux, les petites perturbations (entre 10′ et 2′ d'écart en déclinaison) qui se détachent nettement sur une courbe calme ou peu agitée, satisfont aussi à la loi posée ; et, dans les tableaux publiés, ces petites perturbations sont les plus nombreuses (voir le mémoire original).

Par contre je n'ai pas considéré les parties, d'étendue souvent grande en longitude, où l'agitation est continue, après un fort orage ou en dehors d'un orage. Les pointes sont alors petites, nombreuses et très rapprochées, sans offrir de maximum bien net. L'émission correspondante du soleil n'est plus limitée, comme dans les orages S, à une région étroite de l'astre avec des particules plus ou moins rapides ; elle s'étend sur les côtés en longitude, étant en même temps plus faible. Ce mode particulier d'émission sera l'objet d'une étude spéciale.

En résumé, tous les maxima bien nets, grands ou petits, des courbes ont la distribution régulière qui est annoncée ; mais, et il faut insister sur ce point, il y a des lacunes dans leur succession, l'émission solaire étant intermittente, comme l'émission de nos volcans.

Après ces explications, on comprend pourquoi les maxima iT/6, spécialement examinés par le Dr Chree, n'apparaissent pas dans ses calculs ; les moyennes adoptées ont l'inconvénient de masquer les inégalités périodiques dont l'intensité est très variable Seule la période T émerge ; ce qui indique qu'elle est la plus fréquente et qu'elle est attachée à des orages forts ; et ce résultat est certes fort important. D'autre part le caractère magnétique sur lequel s'appuie le Dr. Chree, représente incomplètement l'état des choses, et a été déjà vivement critiqué. La division rigide en tranches de 24 heures, qui convient certes pour l'étude de la variation diurne, est beaucoup moins indiquée pour les orages proprement dits. Pour faire ressortir les périodes T/6 et T/12, il faudrait prendre dans chaque mois non pas 5, mais 14 jours. Enfin mon étude porte seulement sur 18 mois et celle de Dr. Chree sur les onze années d'une période solaire.

Que le Dr. Chree veuille bien étudier séparément, comme je l'ai fait, chaque perturbation, puis la comparer directement aux autres, et son opinion sera modifiée.

II Il reste ensuite à reconnaître dans le soleil les points d'émission corpusculaire dont la distribution régulière est annoncée par notre aiguille aimantée. On a d'abord pensé aux taches, puis aux facules, et je me suis rallié à cette dernière opinion. Depuis longtemps j'ai l'idée que les points actifs du soleil correspondent surtout aux parties de la facule qui présentent la raie D_3 de l'hélium noire, que la facule soit avec tache ou sans tache. La proportion de gaz helium y est plus grande et donc aussi la proportion de corps radioactifs. L'Observatoire de Meudon s'organise pour enregistrer d'une manière aussi continue que possible ces portions spéciales des facules, et d'Azambuja, astronome de Meudon, a commencé la recherche depuis plusieurs mois.

Le mois dernier, l'astronome anglais A. A. Buss m'a signalé une note publiée par lui en 1915 dans *The Observatory* et intitulée : "A possible Systematic Distribution of Solar Activity Areas in Longitude." Sur 57 taches relevées de 1912 à 1914 dans une phase de minimum, Buss en note 10 dont les différences en longitude sont très voisines de 60° ou de multiples de 60° ; et il suggère que cette régularité pourra se retrouver dans les orages magnétiques. L'intérêt du fait annoncé est manifeste ; et on peut s'étonner que l'auteur n'ait pas poussé plus loin cette première étude. Les 10 taches signalées n'étaient pas toutes parmi les plus fortes ; il faudra rechercher si les autres taches de 1912–1914 ont entre elles des différences qui soient des multiples de 30° et de 15°. Il faudra aussi étendre la recherche aux facules avec taches ou sans taches et aux perturbations magnétiques d'une période solaire tout entière.

III. Le rayonnement corpusculaire du soleil a été jusqu'ici plutôt négligé ; or il a une très grande importance et s'annonce comme étant la cause première de la plupart des grandes variations que subissent le soleil et ses dépendances dans la période undécennale. Le phénomène toujours mystérieux des champs magnétiques intenses, reconnus au Mont Wilson sur plusieurs points de l'astre, est dû peut-être à ce rayonnement. Une propriété remarquable des particules électrisées est ici à rappeler : lorsque ces particules ont traversé une certaine quantité de matière, elles ont une trajectoire hélicoïdale (Wilson, Rutherford). Si les hélices ont des rotations de même sens sur une portion un peu notable de la surface, il en résulte un champ magnétique, à composantes horizontale et verticale, très semblable à ceux du soleil. On peut aussi, avec ce rayonnement corpusculaire négatif et positif, expliquer en grande partie les facules, les taches avec leurs deux polarités, les protubérances et filaments : et on s'accorde déjà pour lui attribuer les formes caractéristiques de la couronne solaire.

H. DESLANDRES.
(Directeur.)
Observatoire d'Astronomie physique,
Meudon, le 20 Septembre.

Science and Psychical Research.

NICKNAMES are seldom exhilarating or welcome, especially when intended to be contemptuous, so the question raised on p. 553 (NATURE, October 16), whether Prof. Richet can rightly be bracketed with Crookes and Lodge as a 'spiritist,' seems a barren one, but it may be used as a peg for some general remarks.

None of the three would like the term ; all would prefer to be regarded as explorers or gropers in a tangled region off the obvious track, but only one of the three would resent the term as definitely erroneous.

I suppose it is generally admitted that there are facts requiring explanation If the facts are all explicable in terms of human duplicity, the only branch of science to which they can be of the smallest interest will be anthropology or abnormal psychology or psychiatry. But if any of the facts are what we may call for brevity 'real,' they are bound to be sooner or later of importance—even of great importance—not only to psychology but to physiology also, and perhaps to humanity at large. All three of the above-mentioned protagonists have gradually come to believe that that is so, in opposition to many of their colleagues who are still labouring under the delusion of undiluted fraud.

May I assume for the moment that some of the unpalatable or undigested facts are real, in the sense

that when understood they will lead to an extension of natural knowledge. We now require a working hypothesis wherewith to tackle them. The particular hypothesis employed as a tentative clue is comparatively of small importance; and if any onlookers are unwise enough to elevate such vague notions to the rank of a theory, they can scarcely be aware of the high status required of a scientific theory. A working hypothesis is an elastic thing, or rather a living and growing thing; parts can be shed, parts may become consolidated, while other parts may shoot out new growths and bud amazingly, but all are variable; and various hypotheses may be favoured at different times and by different people.

Of the hypotheses so far tried to account for strange happenings, one group of scientific men ejaculate 'fraud'; another set try what they can do with 'ectoplasm'; while a small group, in sympathy with these last, try to go further, and postulate unrecognised intelligences; so this last group may be represented as murmuring 'spirit.' But none of these hypotheses is an explanation: indeed, only the first class imagine that they have an explanation, though if they press it with care and patience they will find if often does not work. Let us give the other two a moment's chance.

By ectoplasm, Richet and his group mean a mass of protoplasmic material, emanating under exceptional conditions from the human body, and endowed with singular and unexpected properties; no more astonishing in themselves than the properties exhibited by an egg, or indeed any other form of living tissue, but unusual in location and also unusual in the apparently temporary character of the result. Like muscle, ectoplasm is controlled by intelligence and can exert force, but unlike muscle it extrudes itself beyond the normal periphery of the familiar organism. Like a placenta or an egg or a pupa, it exhibits a formative power, being able to manipulate itself or other substances into organised forms; but, unlike the forms to which we have grown accustomed, these are singularly evanescent. Nevertheless, while they last they act in an intelligent way, and are as subservient to control as, let us say, a dog. Such are among the facts testified to by Richet, Schrenck-Notzing, Morselli, and other continental investigators.

If we grant all or any of this, merely for the sake of the discussion—for facts are not established by citation of authority—the question arises, What is the control? Is it the unconscious mind of the person from whom the substance emanates—naturally the first and easiest idea—or does it represent the intervention and activity of some intelligence not obviously and in perceptible form present? The three men mentioned above, though sometimes bracketed together, might take different views. I venture to say that their views, whatever they are, must at the present stage be so crude as to be scientifically almost negligible. The facts alone are important; it is those that, granted their genuineness, need far more investigation. In that opinion they all agree. Time enough for a theory when we know more.

In fairness, however, let me go on to excuse, and in some sort justify by an analogy, the third kind of working hypothesis here briefly labelled spirit. Consider the reaction of a race of secluded but intelligent aborigines to whom there comes a rumour, from one or two of their number, about things quite inconceivable and absurd—X-rays, let us say, or telephones, or radio telegraphy. At first utterly sceptical, they may denounce and expel the heretic; but if, nevertheless, the rumour is persisted in by successive generations, and supported by some whose observations are generally treated with respect, some working hypothesis becomes necessary. Delusion is the simplest notion; the idea of corporeal emanations and vibrations is more troublesome, but may be made to look impressive and materialistic; while the hypothesis of the existence of a hitherto unsuspected race of white men, to whose activity the phenomena are due, would probably be stigmatised as a degrading superstition. Whatever it is, it is certainly not a theory of X-rays or of telegraphy; and yet the suggested clue that these incredible things are the work of unknown intelligent operators has, in this case, an element of something that would ultimately lead to an explanation. It may be sneered at as superstitious, but cannot rationally be stigmatised as false.

So also the hypothesis popularly associated with the term 'spirit,' though it is not a theory of either apparitions or telepathy or telekinesis, yet in so far as it contains any element of truth—that is the crux—it may be the beginning of what will ultimately constitute a new branch of science. It may be only the first rung of a ladder; yet if we follow our leaders and begin to climb, who knows what unearthly region may be ultimately scaled! Science is young: the human race may reasonably be expected to continue on this planet for several million years; so it would be rather dull, as well as unlikely, if man's outlook on the universe, and his realm of natural knowledge, should always conform to the orthodoxy of A.D. 1926.

OLIVER LODGE.

The Naming of Wild Hybrid Swarms.

ONE of the most important developments of botanical research in New Zealand of recent years, since it concerns not only taxonomy but also the question of evolution, is that of the study of wild hybrids. Evidence has rapidly accumulated as to the prevalence of polymorphic swarms of wild hybrids in several sections of the flora. Whereas (*Trans. N.Z. Inst.*, **44**, 1912, 30) Cockayne stated, "Hardly anything is known as to the occurrence of wild hybrids in New Zealand," he was able later (*New Phytol.*, **22**, 1923, 124) to list 130 certain or extremely probable groups of interspecific hybrids. The number has since been considerably augmented, and now stands well above 200. The following table is illuminating, taking only the monocotyledons and dicotyledons.

Classes of Genera.	Number of Genera.	Number possessing Hybrids.	Percentage.
Genera with 2-5 species	125	42	34
Genera with 6-10 species	33	17	52
Genera with 11-20 species	15	13	87
Genera with over 20 species	16	16	100

All genera containing 14 or more species are known to show hybridism. Remembering that many species are so isolated that hybridism is difficult or impossible, that species in close proximity may bloom at different seasons, and that many groups have not been critically examined in the field, but the vague term 'variation' has been used to explain polymorphy, these figures speak for themselves

Now this wealth of wild hybrids raises many important questions, not the least of which, as a necessary preliminary to further progress, is the matter of suitable nomenclature. The formular treatment allowed by the "International Rules of Botanical Nomenclature" is too cumbrous for general and field

studies. Nor do the "Rules" have in view the existence of the highly polymorphic hybrid swarms—in no few cases hundreds or probably thousands of distinct individuals—that are now known to exist. In the absence of any recognised method of procedure suited to our needs as field ecologists, we have been forced to draw up our own rules. Elsewhere we are publishing a more detailed statement of our case, but it seems well to place the essence of the matter before the wider audience available in the columns of NATURE.

For the whole diverse group arising from the crossing of two species we construct a name formed by the combination, suitably abbreviated, and with the ending appropriately modified, of the specific names of the parents. Thus to the great group *Hebe elliptica* × *salicifolia* we give the name × *Hebe ellipsala*, and so for *Hebe Astoni* × *laevis* the name × *Hebe laevastoni*, preferring euphony to strict adherence to alphabetical order. Where one of the names is quite short it may be used entire, *e.g.* *Melicope tersimplex* = *M. simplex* × *ternata*. This idea is derived from names given to horticultural hybrids, *e.g.* × *Iris monspur* = *I. Monnieri* × *spuria*. Where a specific name has been given to a smaller group within the swarm, as has often happened, especially for forms about midway between the parents, we may adopt this name for the minor group. Thus *Melicope Mantellii* is the name we propose for that small group of hybrids "intermediate" between *M. simplex* and *M. ternata*.

To us it seems most inappropriate to widen the conception of such names to include the whole group, as not only have we no warrant for doing so, but also confusion would inevitably result. Moreover, our method provides for the placing of forms still undiscovered, or those certain to arise later. A hybrid swarm is a totally different biological group from that of a species. In the latter case there can be a "type", in the former a "type" is impossible. Further, species deal with definite, static groups, but hybrid swarms with indefinite dynamic groups, for the hybrids of to-day are being replaced before our eyes by other forms, yet for these the group name will serve. The name *Nothofagus Blairii* is that of an extremely small group of the vast swarm *N. cliffortioides* × *fusca* (× *N. cliffusca*), but were the name *N. Blairii* used for the whole swarm its original conception would vanish, for it would include forms having no characters in common with *N. Blairii*, as originally described, and possessing characters not known previously in the genus, *e.g.* almost circular leaves with blistered surfaces.

The procedure outlined above seems to us adequate, of easy application, and helpful in revealing the parentage and history of the hybrids, whereas an arbitrary name reveals little or nothing. To one versed in the names of New Zealand plants, × *Aristotelia fruserrata* at once tells the group is *Aristotelia fruticosa* × *serrata*, whereas to apply the name × *A. Colensoi* to the group not simply tells nothing, but also actually misleads, insomuch as the 'species' *Aristotelia Colensoi* was based on a non-flowering specimen taken from a shrub some seventy years ago that is almost certain to have died some time back, and could not now be matched by any living plant.

Another matter to be considered is the citation of authors' names for hybrids, this not being fully provided for in the "Rules." Thus, if for any reason we still maintain Cheeseman's name *Ranunculus Matthewsii*—it was based on two specimens taken most likely from one individual—for a very limited portion of the large polymorphic group *R. Buchanani* × *Lyallii* we should cite it as × *Ranunculus Matthewsii* (Cheesem.) Ckn. et Allan as hyb., but by the "Rules" we need not use that name at all in moving the group it represents into a group of such a different status as a hybrid swarm.

The "Rules" demand diagnoses in Latin for hybrids as for species. This is all very well for small groups made up of fairly uniform individuals, and many such diagnoses occur in systematic literature. Obviously, however, with the groups we are considering, *e.g.* × *Myrtus bullobcordata* with its hundreds of distinct forms, diagnoses of reasonable length must be vague in the extreme, and we think that this requirement should be abandoned. This, of course, does not gainsay that detailed analysis of the individuals composing the groups is imperative.

Since the whole matter is of not merely local interest, but also applies to all floras and is particularly important from the point of view of definite names for the use of students of evolution, and since some commonsense uniformity of treatment is highly desirable, we bring the subject forward in the hope of arousing discussion, so that perhaps some such procedure as we have indicated may be adopted, and suitable rules drawn up for insertion at a future revision of the "Rules."

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Early Egypt and the Caucasus.

WE are grateful to Sir Flinders Petrie for constituting himself his own reporter (NATURE, Oct. 9, p. 514) in the matter of his reply to our papers at Oxford, for we had at the meeting no opportunity to cover the ground on to which he transferred the argument. On that occasion, we kept studiously to the examination of the prehistoric and the geological evidences for the Caucasian-Solutrean argument. The difficulties we indicated (1) cultural, (2) distributional, (3) geological, were left unanswered. If Sir Flinders Petrie prefers to argue on historical ground we have here, too, certain comments to make.

The essential question is stated to be a conflict between (*a*) a 'received view,' whereby the Fayum lake gradually rose by the rise of the Nile level up to '205 or 220' feet above present lake, and (*b*) a 'new view,' whereby a high lake in the early human period was gradually dried down to the present size. In regard to this summary of the position the following comments may be apposite.

The view which is labelled 'received' was formulated in the late 'eighties; the chief contributors to the subject being Hanbury Brown, Scott Moncrieff, Cope Whitehouse, and Sir Flinders Petrie himself (as a result of his excavations of Biahmu and Arsinoe). This was long before the Fayum depression had been geologically investigated. The evidence for two lakes was undreamt of, and none of the palaeontological or stratigraphical work required as a sound basis for what is primarily a geological theory was attempted, nor had these gentlemen the specialised training to do so. It was not until 1905 that H. J. L. Beadnell published the official geological memoir on the Fayum. As is usual in these official surveys, the Pleistocene received relatively little investigation, but the fact was noticed that the upper limit of the lacustrine beds occurred at 223 feet (O.D. 23 m.), and the view was expressed that this gives evidence for "a great fresh-water lake in Pleistocene and prehistoric times."

The chief authors of the 'received view' do not appear to be in agreement between themselves.

Sir Hanbury Brown writes: "There is nothing to support the theory that there has been any great change in the Nile levels since the waters first found their way into the Fayum," and he believed that the old high-level lake was controlled and artificially kept at 222 feet in XII. Dynasty times. Sir Flinders Petrie, on the other hand, believes that instead of the prehistoric lake being at a more or less constant high level, it was gradually rising, reaching a height of about 205 feet (O.D. 17 m.) in XII. Dynasty times, attaining its full maximum of 220 feet (O.D. 22 m.) in Ptolemaic times.

With regard to the 'new view' (*b*), may we point out that we found abundant evidence for the existence of two lakes, the older corresponding to the 220-foot level; the newer never exceeding a maximum of 205 feet, which was attained in prehistoric times. From this point a steady fall appears to have taken place; the Fayum industry is closely linked to its 190-foot stage and lower, thus limiting the waters of the historic period to something below this level. We should like to add, what is not clear from Sir Flinders Petrie's statement of our case, that we consider, so far as the evidence is available, that both lakes were connected with the Nile, but the nature of this connexion cannot be definitely stated until detailed investigation has been undertaken along the Lahun-Hawara channel.

Our answers to Sir Flinders Petrie's six reasons in support of his view are briefly as follows:

(1) There is no evidence as to the depth of the inlet channel. As regards the question of siltage, geologists with knowledge of modern rivers under similar natural conditions regard blockage as highly probable, and Hanbury Brown himself considered that the growth of rushes in the channel "would check the inflow, and, while preventing the rise of the lake, would favour silt deposit."

(2) Completely ignores the probability of climatic change in Quaternary times, to which the other oases bear witness.

(3) The interpretation of the name "Soknopae Nesos" is not sufficient evidence to counteract hard geological facts.

(4) Schweinfurth notes especially the abundance of ruins around the edge of the basin, and it seems probable, from topographical considerations, that the nature of the underlying ground controlled the choice of site, rather than the relation to the lake level. The partially consolidated lake deposits would give but poor foundations for the massive ancient stone buildings. It should also be noted that dynastic flints were found at levels which would have been submerged at that time according to view (*a*).

(5) Of the four stone structures regarded by Sir Flinders Petrie as quays, three lie at Qasr-el-Sagha; these are known to him by photographs only. The fourth is the termination to the long paved road leading south from Dimê Temple; evidence points to this being not earlier than the first century A.D. The three structures at Qasr-el-Sagha show rough slabs of stone capping outstanding ridges of old lacustrine beds. This accounts for their approximately uniform height. The loosely consolidated material upon which they are based would not serve as foundation for a 'quay.' We are supported in our view of them by several archæologists, who came over at our request to see them, and are emphatic that such structures could not serve as quays. Further, one of these would, on Sir Flinders Petrie's rising levels, have been an island.

(6) The value of Herodotus as a witness can be judged from the fact that his estimate of the circumference of the lake was at least 87 miles too big, supposing the water to have stood at the 220-foot level in his time.

G. CATON-THOMPSON.
E. W. GARDNER.

Bedford College, London.

The Occurrence of Helium and Neon in Vacuum Tubes.

A SHORT time ago we published (*Proc. Roy. Soc.*, A, **109**, 186, 1925) an account of some attempts to confirm the observations by Collie, Patterson, and Masson (*ibid.* **91**, 30, 1915) of the occurrence of helium and neon in vacuum tubes. In view of the fact that we were able to obtain small quantities of these rare gases by passing the discharge through oxygen at low pressures when a magnesium or aluminium anticathode coated with nitride was used, no trace being found in the absence of the nitride, we attributed their formation to the disintegration of the nitrogen atom. Success depended on the use of an induction coil provided with a hammer break rather than a mercury break, an observation which agrees with those made by the previous authors.

We have now carried out some further experiments which would seem to confirm our original results. In the first place, both helium and neon have been obtained by passing the discharge between a concave aluminium mirror as cathode and a magnesium anode through a mixture of oxygen and nitrogen under reduced pressure. No trace of the rare gases was formed if the discharge were passed in the opposite direction; and since in this series of experiments the two types of discharge were used alternatively, the same mixture of oxygen and nitrogen was used, and the apparatus was not changed in any way, this would obviate any possible criticism that the rare gases had their origin in an air leak.

In the second place, the rare gases are produced when the condensed discharge is passed between aluminium wire electrodes through mixtures of oxygen and nitrogen, no result being obtained in the absence of the condenser. In these experiments the character of the discharge was found to be of great importance, as the production of the rare gases depended on the length of the auxiliary spark-gap, the capacity of the condenser, and the pressure of the gases. An increase in the gas pressure necessitated an increase in the length of the spark-gap. Considerable trouble was at first met with, owing to the fouling of the mercury in the exhaust pump by ozone and active nitrogen, and this difficulty was surmounted by interposing a vessel containing boiling mercury.

In the third place, the aluminium of the electrodes was replaced by tungsten; and in view of Boomer's observation that active helium is readily absorbed by this metal (*Proc. Roy. Soc.*, A, **109**, 198, 1925), we confined ourselves to the examination of the electrode splash. Little or no splashing occurred until the pressure of the nitrogen-oxygen mixture was reduced so far that the discharge tube phosphoresced strongly. After the discharge had been passed for sixty hours the electrode splash was heated, and helium and neon were obtained. In these experiments a 14-inch spark coil was used and supplied either with alternating current (110 volts, 50 cycles) or with direct current, using a mercury break. A condenser and auxiliary spark-gap were used in both cases.

Lastly, we have obtained a successful result by passing a condensed discharge between two tungsten electrodes about 1·5 inches apart in mixtures of oxygen

and nitrogen at atmospheric pressure. Before use the electrodes were strongly heated in a vacuum to remove all occluded gases. After passing the discharge for sixty hours, the electrodes were strongly heated and, after removing a small trace of hydrogen, pure helium was obtained. This result is one of very few in which helium has been obtained without the presence of neon, and may be accepted as a final disproof of any contamination by air. Moreover, no rare gas was obtained with the uncondensed discharge in the same apparatus.

These more recent results would seem to establish the reality of the formation of helium and neon in vacuum tubes, and completely to confirm the original observations by Collie, Patterson, and Masson. As regards the origin of these gases, we believe that they arise from the disintegration of the nitrogen atom. Attention may be directed to the fact that hydrogen is always to be found in the residual gases along with the helium and neon, although the greatest possible care was taken to remove it from the electrodes before each experiment. At the same time it may be pointed out that in spite of all precautions it is impossible to secure the total absence of oxides of carbon. Whilst it seems very improbable that our last recorded observation at atmospheric pressure can be attributed to the disintegration of carbon, it may be mentioned that Bell and Bassett (*Science*, 56, 512, 1922) noted the presence of helium lines in the spectrum of the negative tongue of the Sperry searchlight and suggest that this gas is produced by the disintegration of the carbon atom.

E. C. C. BALY.
R. W. RIDING.

Chemical Laboratories,
University of Liverpool, September 27.

The Canadian School of Prehistory in France.

THE Canadian School of Prehistoric Research in France was started in Ottawa, Canada, in May 1925, when twelve fellows of the Royal Society of Canada were elected on a committee for the object in question. The first year's work in France under the auspices of "Les Beaux-Arts de France" in Paris, Ministry of Public Instruction, Department of Historical Monuments, etc., has just closed its labours, and the School can now be stated to have been fairly well launched and started, having gathered a rather extensive and interesting lot of materials for study and distribution to various academic and scientific centres throughout the Dominion.

The site, or *gisement*, granted by the Beaux-Arts to Canada is situated in the Dordogne district, at Combe-Capelle, near Monferrand, up the beautiful valley of the Couze river, Commune of St. Avit-Sénieur. Amongst the many problems in prehistory to be solved, there occur a number at this locality, as well as in other not distant *gisements*, including La Micoque and other Moustierian sites of the Vézère valley.

Combe Capelle was expected to yield some information desired, and the result of the work of the Canadian School at this site, in June, July, and August, has revealed a certain amount of excellent material—especially at the base of the section examined—bearing upon some of those problems. No sensational discoveries were made in this virgin piece of excavation, but a large amount of worked-stone implements of a very primitive sort were found in four distinct layers or beds at Combe-Capelle.

Two nearly complete skeletons of a fairly large rodent (Marmota), besides isolated and fragmentary bones and teeth of bison, equus, rhinoceros (?), were added to the collections of flint or stone implements made on the spot. The work was undertaken as a careful and methodical piece of investigation under the auspices of the Beaux-Arts in order to obtain certain definite results. Very curiously and roughly shaped implements were found in all of the four layers traversed, being especially abundant in the oldest two beds. Types not hitherto much heeded, on close examination, proved to be either new or unrecorded implements made by Moustierian man as revealed in the Combe-Capelle station, exhibiting much cleverness and skill, as well as resourcefulness in the result of his industrial achievements in stone.

The type of human beings living in this very early stage of man's civilisation utilised even the simplest, rudest, or most common type of flint-flake, obtained by one or more well-directed blows given by his right hand or left hand, holding a *percuteur* or hammer, and from this flake wrought a number of fascinating shapes of instruments for his everyday use, whether it were for hunting, skinning animals, cleaning hides, building canoes, or for domestic purposes.

This ancient citizen of the Couze valley, like Moustierian man of other parts of France, of the Channel Islands, and of Great Britain, made a number of racloirs (scrapers), tranchets, blades, knives, saws, and other tools of rough, yet of intelligent workmanship. All the implements found reveal, as of to-day, two types of men: one, careful and industrious, taking an intelligent interest in his work; the other, careless perhaps and heedless of the advantage of turning out a well-made tool, satisfied with a comparatively inferior article to meet his tastes in all likelihood. There were good, fine, and well-made implements discovered at Combe-Capelle, of materials carefully chosen, carefully wrought, which any one, even a twentieth-century man, might be proud to be able to produce. Time, evidently, was not of very much consideration, and amongst the best, or carefully made tools, some must have taken quite a long time to make.

Careful study of the various types discovered at Combe-Capelle by members of the Canadian School in France remains to be made, and it is hoped that excellent results will be achieved, besides the procuring of specimens to illustrate the various epochs in the history of human civilisation, for which France is specially noted:

The Chellean Period (Chelles in Seine and Marne); the Acheulean (Somme valley): Moustierian (Vézère valley), Aurignacian (southern France and at Cro-Magnon in Les Eyzies), Magdalenian (La Madeleine, of the Vézère valley); the Azilian (Mas-d'Azil, of southern France), and the Tardenoisian (Tardenois-en-Fer)—all French stations marking the advancement and progress of humanity throughout the ages of man in Quaternary times, in the last chapter of the history of life on this planet.

H. M. AMI.

London, September 25.

Liveing's Fire-Damp Indicator.

THE author of a note on p. 497 of NATURE of October 2, while giving credit to E. H. Liveing as the originator of the method of detecting and measuring fire-damp by means of an electrically heated platinum wire, wrote: "The apparatus in skilful hands would certainly measure fire-damp, but its value lay rather in its promise than in its practical utility." I desire to protest against this disparaging statement. I helped Mr. Liveing to make his original magneto-electrical machine, for this was before the days of the Faure battery or the Clowes hydrogen lamp. While

all sorts of physical laboratory methods for comparing the temperatures of the two platinum helices, for example, Wheatstone bridge, etc., were considered. Liveing elected to adopt the more simple photometric device of a sliding white angle block placed between the two sources of light. When the two sides appeared equally bright the position of the block read against a scale indicated the proportion of fire-damp. This was an operation which a fireman could perform quite as quickly and easily as the usual one with a 'cap.'

Not long after the development of this instrument, I went at the instance of Mr. Fletcher, of Bolton, to investigate fire-damp in his own and in some neighbouring fiery pits. Its practical utility was such that, at any place selected, about a quarter of a minute was sufficient to turn the handle, slide the block, and read the proportion from ½ per cent., the lower limit, up to about 2 per cent. While I was in Bolton there was a minor explosion of fire damp in a neighbouring pit, and Mr. Fletcher and I went there immediately. On reaching the place where the gas had fired the safety lamp filled with flame. On collecting gas from the roof I found it to be practically pure fire-damp, for, like hydrogen, it quenched the wire exposed to it in consequence of its greater mobility. If instead of writing "practical utility" the author had used the expression "general adoption," he would have been right. At this time the really practical man had much influence. He suspected instruments which he did not understand, and he did not want to have fire-damp found even in minute quantities where none could be detected by the usual means, and where therefore no danger existed.

C. V. BOYS.

IN my note I had no intention of disparaging the very ingenious invention of Mr. E. H. Liveing; on the contrary, I wished, while commenting on a new application of the same principle to recall the fact that the credit of utilising the increased glow of a heated wire over which a methane-air mixture is drawn, as a measure of the methane present, is due to Mr. Liveing. Like Prof. Boys, I tested the apparatus both near working faces and in the return airways of mines which gave off fire-damp. Although I cannot claim to approach Prof. Boys's unique experience in photometric work, I had had several years' practice in comparing the illuminating power of lights—and especially of lights of different tints—and I found it possible to make concordant readings with the instrument. But my companions—men of great mining experience—did not agree with my readings, or with each other's. The impression formed by me was that the indicator was not adopted because the mine-managers thought (rightly or wrongly) the instrument allowed too much margin to the 'personal equation.'

THE WRITER OF THE NOTE.

The Imaginary Roots of Equations.

IN discussing the stability of an oscillating system, it is often necessary to know whether the period-equation has any root the real part of which is positive. We proceed to show how to find out the number of such roots. Let the equation $f(z)=0$ be of degree n and let $f(iy)=u+iv$ where u and v are real. If v is of higher degree than u put $f_1(y)=-v$, $f_2(y)=u$, otherwise put $f_1(y)=u$, $f_2(y)=v$. Go through the operation of finding the G.C.M. of f_1 and f_2 with the difference that the sign of each remainder is changed before it is recorded or used as a dividend (just as in getting Sturm's Functions), and let the remainders (with changed signs) be $f_3(y), \ldots f_m(y)$. Let the number of changes of sign in the sequence $f_1, \ldots f_m$ be χ when $y=\infty$ and χ' when $y=-\infty$. Then the number of roots of $f(z)$ having their real parts positive, less the number having their real parts negative, is $\chi'-\chi$. If now there are r real roots of the common divisor $f_m(y)$ of f_1 and f_2, then $f(z)$ has $(\chi'-\chi+n-r)/2$ roots with the real part positive, $(\chi-\chi'+n-r)/2$ with the real part negative, and r purely imaginary roots.

For proof we divide f_1 and f_2 by $f_m(y)$ and $f(z)$ by the corresponding factor $f_m(-iz)$, and then find the increase in argument of $f(z)/f_m(-iz)$ on going round the positive half plane by considering its passages through $n\pi$ in the first case or $\pi/2+n\pi$ in the second. The number for the infinite semicircle is the degree of $f(z)/f_m(-iz)$, and that for the axis of y is found by reasoning very similar to that used for Sturm's Functions to be $\chi'-\chi$.

H. C. POCKLINGTON.

6 Blenheim Crescent,
Leeds.

Spatial and Time Relations in Dreams.

THE letter with regard to so-called 'mind-pictures,' printed on page 372 in NATURE of September 11, has greatly interested me because such non-volitional pictures have been very familiar to me from my childhood up. I used frequently to amuse myself by observing them, especially when in bed, just before I went to sleep, but I can bring them on by closing my eyes at almost any time. They are non-volitional in the sense that I do not knowingly control their content. So far as my consciousness is concerned, I am simply in the position of an observer. The pictures are of moving events and include landscapes with persons and animals, buildings, trees, vehicles, etc. I am totally ignorant at any one moment with regard to what may appear on the scene at the next, and the whole thing is as interesting and amusing as if I were observing an actual scene. The fact that I do not amuse myself with these pictures in my adult age as I used to do as a child, I attribute to the fact that they are mentally tiring. Their production must involve some expenditure of energy in the brain in a way of which I am ignorant.

ARTHUR E. BOSTWICK,
Librarian.

St. Louis Public Library,
St. Louis, Mo., September 30

The Influence of General Electron Displacement on the Reactivity of Conjugated Systems in the Molecules of Carbon Compounds.

IN the September issue of the *Journal of the Chemical Society*, Baker and Ingold state that the nitration of benzoic esters is being investigated at Leeds. A similar study is in progress in these laboratories, and preliminary results show, for example, that the proportion of the *m*-nitrobenzoic acid derivative obtained on nitration rises in the series $Ph.CO_2 \leftarrow CR_3$ ($R =$ alkyl), $Ph.CO_2.CH_3$, $Ph.CO_2 \rightarrow CH_2 \rightarrow C_6H_4NO_2$. This is in accordance with the writer's theoretical views (*Chemistry and Industry*, 1925, 44, 118, 563; Allan, Oxford, Robinson, and Smith, *J. Chem. Soc.*, **129**, 401, 1926; Ing and Robinson, *ibid.*, 1655), and it is anticipated that the nitration of benzoic esters (and of substituted benzamides) will afford a convenient auxiliary method for the estimation of the electron affinities of various groups. The arrows show the assumed direction of displacement of electrons, methyl benzoate being the standard of reference.

R. ROBINSON.

The University, Manchester,
October 10.

The *Discovery* Expedition.

By Dr. STANLEY KEMP, Director of Research

August 18, 1926.

THE R.R.S. *Discovery* left Falmouth on October 5, 1925, and, after touching at Las Palmas and Ascension Island, arrived at Cape Town on December 20. On this passage apparatus and nets were tested, and certain defects which were found were made good. Later passages, until our return to Cape Town in June of the present year, are shown in the accompanying track-chart (Fig. 1).

We left Cape Town on January 17, delivered mails and stores at Tristan d'Acunha on January 30, and sailed for South Georgia on February 1. During the first few days very heavy weather was experienced and we were driven far out of our course by gales of almost hurricane force from the west and south-east. On the passage five deep-water stations were taken. We sighted our first iceberg on February 16, and arrived at Grytviken, in Cumberland Bay, on February 20. For about two months from this date we were engaged in observations on the whaling grounds, sailing for the Falkland Islands on April 17 and arriving in Port Stanley on April 25. A short cruise was made to Falkland Sound (northern end), where whales had been reported, and on May 20 we left on the return passage, laying a course to the north-east in order to pass the reported position of two shoals. On the passage nine full stations were taken and large plankton nets were towed at intervening points. Strong westerly winds and high seas prevented us from making as many observations as we had hoped. We reached Cape Town on June 29.

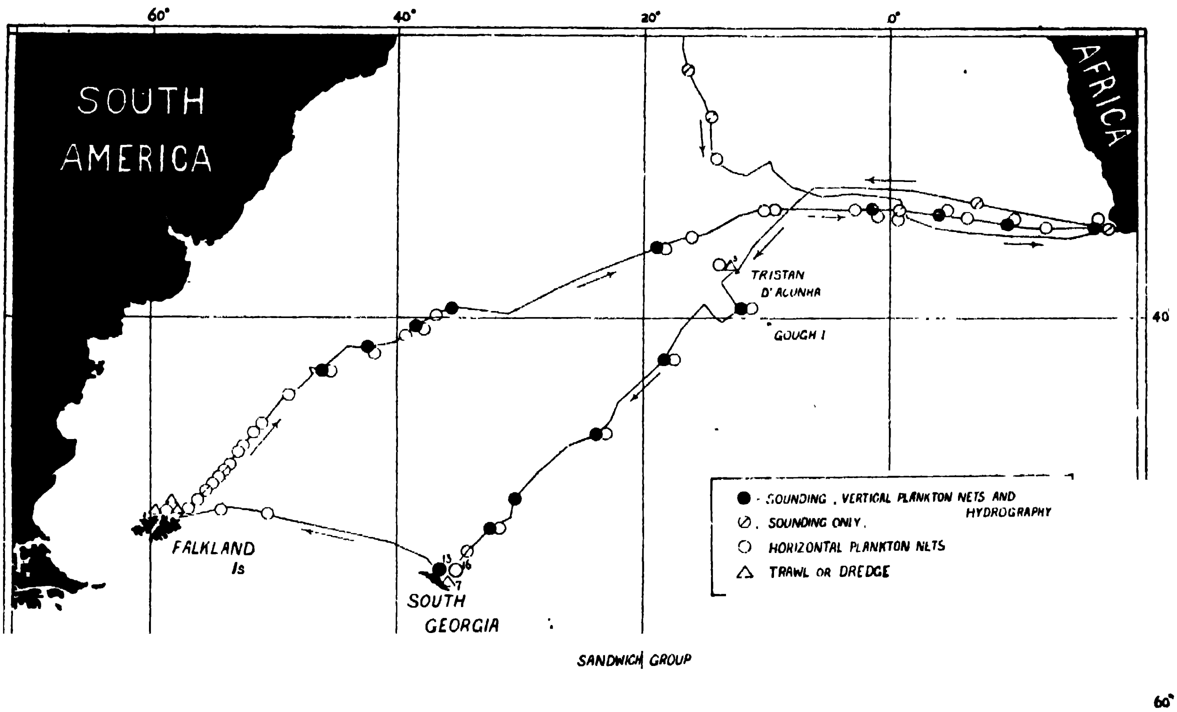

FIG. 1.—Track-chart of the R.R.S. *Discovery*, November 1925 June 1926.

An account of the *Discovery* expedition and its objects has already been published in this journal (vol. 115, 1925, p. 950), and our principal aim during the recent cruise was to carry out a biological and hydrographic survey of the South Georgian whaling grounds. In this we were largely frustrated by the bad weather which prevailed. Data of considerable interest were, however, obtained and experience acquired which will be of great value in our next attempt.

During the 1925–1926 season the whaling grounds at South Georgia were situated on the shelf on the north-east side of the island in soundings of 200 to 250 metres. In this area, at the time of our visit, Euphausian Crustacea were plentiful and *Euphausia superba*, which in our experience forms the only food of fin and blue whales, was often extremely abundant. *E. superba* is a comparatively large species, too active to be caught in vertical nets; to obtain adequate samples it is necessary to use nets towed horizontally. We have not yet sufficient material for a study of the life-history of this species. On the whaling grounds we obtained a few very early post-larval forms, while the great majority were in stages just short of sexual maturity. An Amphipod of the genus Euthemisto occurs in prodigious numbers in the same area and appears to feed almost exclusively on young Euphausians.

As regards hydrographic conditions on the whaling grounds, the most striking feature was the existence of a cold middle layer, with temperatures of about 0° C. at a depth of some 150 metres. This layer was

found to within about ten miles of the shore and, as shown by observations taken on our passage from Tristan d'Acunha, extends seaward to 50° 26′ S. The salinity increased regularly from about 33·7 per thousand at the surface to 34·3 per thousand at the bottom. As might be expected, at the end of the season Diatoms were almost absent on the whaling grounds, but a dense patch of *Thalassothrix longissima* was found in 51° 55′ S. and another of *Rhizosolenia polydactyla* between South Georgia and the Falkland Islands. Phosphates showed very high values in the whaling area, the readings, expressed in mgm. per m.^{3}, varying from 102 to 108 at the surface to 183 at the bottom. Hydrogen-ion concentration varied from 8·26 at the surface to 7·96 in the lower layers.

During a short cruise to the northern end of Falkland Sound, quantities of *Grimothea gregaria* were taken. This decapod Crustacean, which is the pelagic post-larval stage of the rock-lobster, *Munida gregaria*, no doubt forms the food of the rorqual whales which periodically visit the islands.

Large midwater nets have been hauled on numerous occasions, more particularly on the passage from the Falklands to the Cape, yielding collections which should add greatly to our knowledge of the plankton of this region. Among the more interesting forms are great numbers of Diphyids, including a species with scarlet zooids, several pelagic Nemertines one 13 cm. in length—Decapods with luminous organs belonging to the genera Sergestes, Systellaspis, Hoplophorus, and Stylopandalus, the Pteropod Schizobrachium, Thaumatolampas, and other peculiar Cephalopods, and, among the fish, Chiasmodon, Cynomacrurus, and *Stylophthalmus paradoxus*.

The Continuous Plankton Recorder has been employed on numerous occasions and has given successful records on runs which exceed 1300 miles in total length. Mr. A. C. Hardy, to whom the invention of this instrument is due, contributes an account of the apparatus and of the results so far obtained (see App. II.).

The 40-feet otter trawl was used on a few occasions in shallow water at South Georgia and off the Falkland Islands. The bottom fauna is very rich and varied, and, particularly in the former locality, quantities of Nototheniiform fish were taken. Among large collections of invertebrates special mention may perhaps be made of the ten-legged Pycnogonid *Decolopoda antarctica*, of which six individuals were obtained. Dredgings off Tristan d'Acunha resulted in large hauls of Alcyonaria and Antipatharia, and it was found that some colonies of the latter were being invaded by a small brilliantly luminous Actinian, apparently allied to the genus Girardia.

Between the equator and Ascension Island, over a distance of some 600 miles, vast quantities of Pyrosoma were seen every night at the surface, giving a most wonderful display of luminescence, and, at a later date, not far from Cape Town, a colony of another species of this Tunicate was caught which must have been fully 8 ft. in length when intact. Patches of discoloration in the water were on one occasion found to be due to the alga Trichodesmium, on others to swarms of Salpa, in which numbers of semi-parasitic Copepods of the genus Sapphirina were obtained.

During the course of the work, 48 deep-sea soundings have been taken and an examination made in the vicinity of a reported shoal lying to the north-east of the Falkland Islands. Latterly, tests have been made with a modified form of the Nansen tube, designed to bring up cores of ooze enclosed in glass tubes. With this apparatus a core of red clay 47 cm. in length, and one of Globigerina ooze 30 cm. in length, have been secured. It is anticipated that still better results will be obtained in the future. At two points between Tristan d'Acunha and South Georgia, in 46° 35′ S. and 50° 26′ S., the bottom was found to consist of a pure radiolarian ooze, a deposit apparently hitherto reported only from the Pacific. The deep-water echo-sounding apparatus unfortunately developed defects which rendered it unserviceable, but repairs have been put in hand and it is hoped that good results will be obtained with it during the latter half of the voyage.

While at South Georgia, the coasts of which are very poorly charted, as much survey work as possible was undertaken by Lieut.-Comm. J. M. Chaplin. He made a special visit in a sailing vessel to Undine Harbour in order to fix positions at the north-west end of the island.

To shoot and haul large nets and to carry out all the operations necessary for modern oceanographic research in a barque-rigged vessel such as the *Discovery* has naturally proved to be a formidable undertaking. The results we have obtained are due in no small measure to the interest and enthusiasm shown by Commander J. R. Stenhouse, who has invariably done his utmost to render the work successful.

A second ship belonging to the expedition, the R.S.S. *William Scoresby*, has recently arrived in Cape Town. She is of the whale-catcher type, and has been designed especially for whale-marking and trawling. According to the provisional programme which has been drawn up, both vessels will be employed on the south-west coast of Africa until the middle of October, the *Discovery* in plankton investigations on the whaling grounds off Saldanha Bay and the *William Scoresby* in whale-marking. Towards the end of October the passage to South Georgia will be made, the *Discovery* taking a southerly route and skirting the pack-ice. At the end of the year the two vessels will co-operate in a survey of the South Georgia whaling grounds, the *Discovery* afterwards proceeding to the South Shetlands, while the *William Scoresby* undertakes trawling in the vicinity of the Falkland Islands. The Marine Station at Grytviken, South Georgia, will be open throughout the season. I append an account of the work at Grytviken.

APPENDIX I.

WORK OF THE MARINE STATION AT GRYTVIKEN.

By N. A. MACKINTOSH.

The Marine Station was established chiefly for investigations on whales brought to the whaling station, and work has now been in progress since February 1925.

The main problems with which the whale work is concerned fall under the following headings: (1) the specific and subspecific identity of southern whales in comparison with their northern representatives; (2) the investigation of various problems connected with the reproduction, growth, and general breeding habits

of whales; and (3) the interrelations of breeding, migration, nourishment, age, adolescence, etc. Data have been obtained from 738 whales examined at South Georgia.

The routine work included under the first heading consists in the collection, by a series of measurements, of statistical records of the bodily proportions of a large number of whales and notes on a variety of external characters taken with the view of determining what characters are constant and to what extent variation may occur. In this way a large body of material has been collected for subsequent analysis. Attention has been paid to such parasites as occur, since the study of the species of external and internal parasites might be found to have a bearing on the distribution of species or communities of whales.

In regard to breeding and the subjects with which it is related, it should be pointed out that whaling at South Georgia is carried on almost exclusively during the southern summer. The indications point to the winter as the period of maximum pairing and calving, and the material so far obtained cannot therefore be regarded as complete until observations have been made which extend over the whole year. In order that these observations can be made, work is now being started in South Africa at Saldanha Bay, where whaling is carried on during the southern winter. In the meantime, some provisional conclusions can be drawn from the results obtained at South Georgia.

The type of information required relates to such problems as the time occupied by the different stages in the reproductive cycle, and the seasons at which they take place, the time required to reach sexual and full maturity, etc., and to the general reproductive potentiality of the stock of whalebone whales in southern waters. A certain amount of evidence has been obtained on a number of these points, and some indication can be given of the lines on which the investigations are developing. A study of the monthly increment in the average length of fœtal fin whales at South Georgia corroborates the theory that both pairing and parturition occur most frequently during the winter months, while the diversity of lengths of the fœtuses taken at any one time shows that the pairing and consequently the calving seasons are relatively extensive. There is evidence that parturition occurs when the fœtus has reached a length of about 6·0 metres, and the monthly average fœtal lengths suggest that this length would in general be reached about the middle of the southern winter. It does not in any case seem possible that the period of gestation can be much more or much less than a year. With regard to the frequency of the recurrence of pregnancy, the most that can be said at present is that whales probably do not become pregnant every year.

The study of the ovaries has revealed no sign of œstrus occurring between October and May, which is in keeping with the supposition that impregnation mostly takes place during the southern winter. The testes also appear to be in a quiescent condition. The inspection of the ovaries of whales taken in South African waters should be of special value in defining the pairing season more exactly.

An important point to be considered is the proportion of sexually immature whales which are killed. In the case of fin whales, about 26 per cent. are estimated to be immature, while in the case of blue whales, the ratio is so high as 58 per cent., a fact to which attention must be paid in considering the effect of the whaling industry on the general stock of whales.

A point of special interest arises from a study of the numbers of blue whales taken at different sizes. There are indications that the majority of these whales approximate to one of three different lengths, two of which represent a stage of growth at which the animal is still sexually immature. This suggests that young blue whales are inclined to visit South Georgian waters at two successive stages in their development towards maturity, living elsewhere between the stages until they grow to the next size. If they make regular annual migrations, the suggestion at once arises that the difference between the first and second sizes represents a year's growth. Then, assuming that the young are born in the warmer waters during winter and travel towards South Georgia during their first spring, it would follow that sexual maturity is reached just three years after birth. This, however, is a point which will need confirmation from a larger body of material, and it is noteworthy that no indications of the same nature have been detected in the fin whale statistics.

In regard to the estimation of the age of whales, there is some indication that the number of corpora lutea, including the traces of very old ones left in the ovaries, may be to some extent correlated with the age of the whale. The evidence is arrived at from a comparison of the length of the whale with the number of corpora lutea, and partly from the fact that blue whales, which appear to be taken in general at an earlier age than fin whales, usually have fewer old corpora lutea in the ovaries.

Several other points of interest have arisen, amongst which are the observation of a curious structure, found only in some immature female fin whales, which consists of a fleshy band bridging the entrance to the vagina, and the finding of a 24-mm. fin whale fœtus. Twin fœtuses have been found on two occasions.

Other work done at the Marine Station includes the chemical analysis of water-samples collected by the *Discovery* and investigations on elephant seals and on the bird life of the island. With the help of a motor-boat, with which the station is now provided, observations have been begun on the rich fauna of Cumberland Bay.

Appendix II.

A New Method of Plankton Research.

By A. C. Hardy.

Hitherto our knowledge of the density and distribution of the plankton has been gained from samples taken at a number of stations within the area concerned. When, as on long cruises, the stations have to be twenty, fifty, or even a hundred or more miles apart, it may be doubted whether such samples are giving a true idea of the planktonic content of the water traversed: at one point one may strike a swarm of Copepods, or between two others miss an important zone of Diatoms. For a long time I have felt the need of an instrument which, by giving a continuous record

mile by mile to scale, would enable one to study and compare the uniformity or irregularity of planktonic life in different areas, to measure the size, varying internal density, and frequency of patches, and to indicate more exactly than can be done with comparable tow-nettings whether any correlation exists between different species.

Whilst on the *Discovery* expedition I have been experimenting with such an instrument, which I am calling the Continuous Plankton Recorder. Numerous little defects and difficulties have had to be overcome; but now that, taken together, more than 1300 miles of plankton have been recorded, it may be of interest to publish a brief description of the instrument and a note of some of the results obtained by its use. It is a development of the simple Plankton Indicator which I used in the North Sea (*Min. of Agric. and Fisheries Fishery Investigations* II, vol. 8, No. 7, 1926), but in place of the silk netting discs, which had to be reloaded for each sample, I have substituted a long continuously moving roll operated by a propeller turned by the water through which it is towed. Like the Indicator, it is used at full speed without stopping the ship.

Fig. 2 is a diagram of the instrument. It has a hollow cylindrical body tapered at each end, is weighted in front and furnished with planes P and P′, a vertical fin V with adjustable rudder R, and buoyancy chamber Q, so that when it is towed at the point T it 'flies' like a paravane in a horizontal position in the water at the required depth. I am greatly indebted to H.M.S. *Vernon*, Portsmouth, which carried out stability tests up to a speed of 16 knots and fitted the present planes and fin in place of those of my own design which proved unsatisfactory.

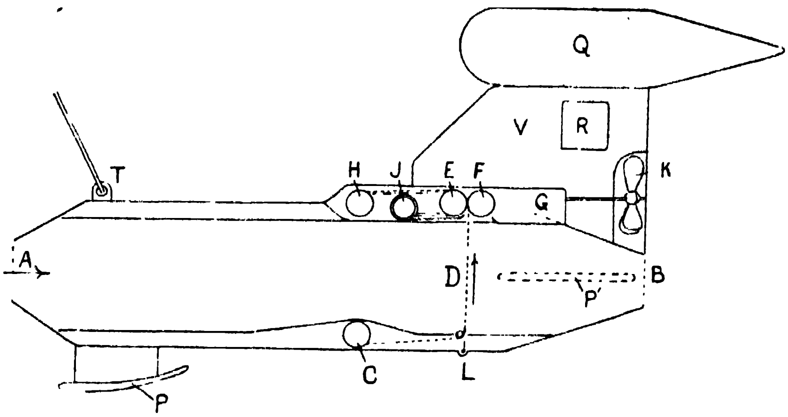

FIG. 2. Diagrammatic section of the continuous plankton recorder.

As the apparatus is towed, water enters through the circular opening A, passes through the cylinder and out at B. A length of silk netting, 9 inches wide and with 60 meshes to the inch, is arranged to wind off the braked roller C across the stream of water at D, where, supported behind by a gridwork of fine rollers, it catches the organisms in the water, then between the driving rollers E and F, which are of soft rubber but with hard ends gripping the edges of the silk, and so on to the storage roller H. The openings A and B, of 4 inches diameter, are smaller than that of D and approximately equal to the filtration area of the netting; a steady flow of water is thus assured, which by its pressure causes the organisms to adhere to the silk. The rollers E and F are driven through the gear-box G by the propeller K, and the storage roller H from E by a chain and friction drive, which prevents acceleration in winding due to its increasing diameter. At J, in a box, is a roll immersed in 5 per cent. formalin; this winds in with the catching roll between E and F, so preserving and separating the layers of organisms on the storage roller H. The instrument is hinged at L and made to open so that the rollers C, J, and H can be quickly taken out and replaced by others. It will be noted that the opening A is not masked by any towing bridle and cuts the water cleanly. The drawings of the instrument were prepared by Mr. M. T. Denne of

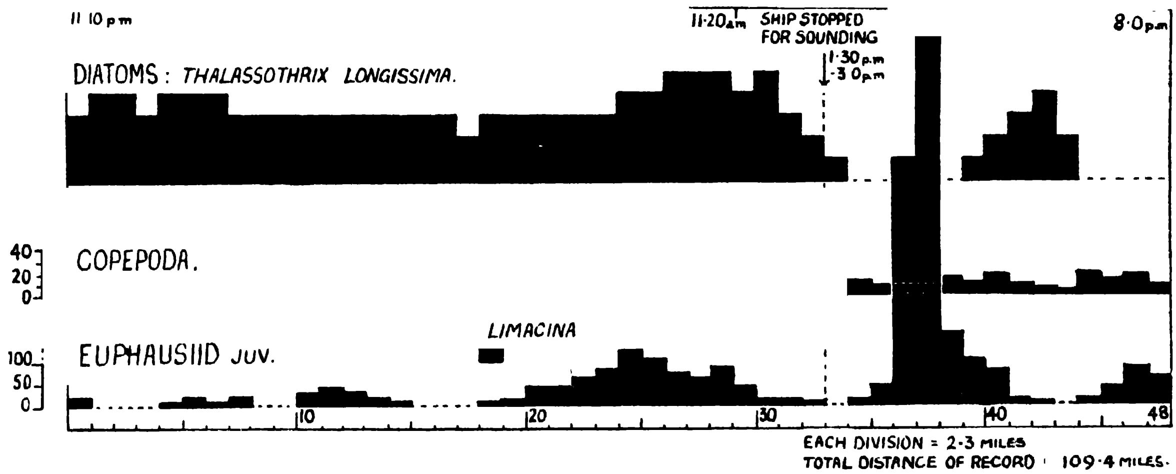

FIG. 3.—Graphic representation of continuous plankton record approaching South Georgia February 18-19, 1926.

310 Regent Street, W., to whom I am indebted for a number of valuable suggestions.

Each silk-catching roll is ruled with transverse numbered lines at 6-inch intervals. Rolls up to 75 sections in length may be used. The blades of the propeller are adjustable so that each section may represent an equal distance of one or more miles as required; the distance actually travelled by the instrument is measured by the ship's log.

At the end of the record the completed roll is unwound across a glass stage with mirror below and examined section by section with a microscope; occasionally an organism may have been removed from the netting for identification. As detailed an analysis is made as may be desired or time permits, from an exact quantitative estimation of all the species to a rough estimation of the general density in different places. The specimens are sometimes damaged in the process of winding, but in nearly all cases they can be identified; in areas where the plankton is well known determination is conspicuously easy. The instrument is not intended for collecting purposes, and, having different functions, is a supplement to, rather than a substitute for, the plankton net.

Fig. 3 shows one of the records obtained; it indicates the distribution of the Diatom *Thalassothrix longissima*, the Pteropod Limacina, the Copepoda, and young Euphausians on a run of 109·4 miles, each section representing approximately 2·3 miles. In the twenty-two records so far made there is evidence of a marked variation in the density and regularity of the plankton in different oceanic regions, and various methods of comparison may be adopted. Discontinuity is expected more in coastal waters, but in mid-ocean sharply defined patches of small Salps, *S. democratica* and *S. longicauda*, Pteropods of the genus Limacina, young Ianthina, Ostracods, Copepods such as *Candacia ethiopica* and *Calanus robustior*, and young Euphausians have been demonstrated. On the other hand, Diphyids and Chætognaths, where they occur, have tended to be constant in numbers. On one occasion, by their occurrence in patches on the roll together, a relation was suspected between small Salps and the Copepod *Sapphirina angusta*; this was afterwards confirmed by living material, the latter being found to enter the former and feed upon the food collected on the endostyle.

Operations with the instrument were temporarily suspended owing to a mechanical defect; this has, however, been remedied, and I hope in the coming season that many more results may be obtained.

City and Guilds (Engineering) College.

THE Duke of York, on October 21, opened the extension of the City and Guilds (Engineering) College at South Kensington, which has been provided by the munificence of the Goldsmiths' Company at a capital cost for building of 87,000*l*. Soon after the Royal Charter was granted in 1907 to the Imperial College of Science and Technology, of which the City and Guilds College forms the engineering department, it was decided that a large extension was necessary to provide adequate equipment for engineering education and research. A site was granted for the purpose by the Commissioners of the 1851 Exhibition to the north of the old college in Exhibition Road, and Prof. Dalby, the Dean of the College, drew up a scheme for three new laboratories: (1) hydraulics, (2) structural engineering, motive power engineering and strength of materials, and (3) railway engineering. Building was commenced in 1911 and completed in 1914, the architect being Sir Aston Webb. The laboratories, one of which is top-lighted, cover an area of 32,900 square feet. Apart from the cost of the building, defrayed by the Goldsmiths' Company, Mr. Hawksley contributed 4000*l*. towards the equipment of the hydraulics laboratory, the governing body of the Imperial College expended 20,000*l*. on equipment, and the Clothworkers' Company has provided 4000*l*. per annum for a number of years towards the cost of research. During the War, the buildings were occupied by the Government for war purposes, the structural laboratories, in particular, being used by the Admiralty as research laboratories.

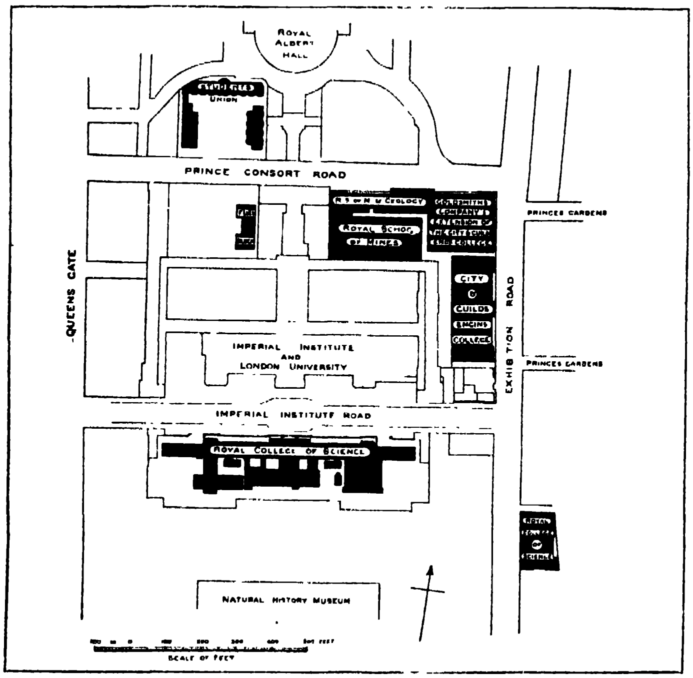

FIG. 1.—General plan of the associated buildings which have been erected on the site of the 1851 Exhibition. The areas coloured black indicate the buildings of the Imperial College of Science and Technology

The main building of the extension is in the shape of a letter **L**, the short arm facing Exhibition Road and the long arm Prince Consort Road, the space in the angle being filled by the top-lighted laboratory. The façades are pleasing and well-designed, and the building forms a worthy addition to the great group of educational and public buildings for which South Kensington is famous. Equipment has been provided

for the laboratories on a generous scale with the double object of training engineering students and providing for research. With the old building the new extension forms a complete unit providing undergraduate training in all branches of engineering for 500 students, post-graduate instruction for between 50 and 100 students, and opportunities for research.

In the unavoidable absence of Lord Buckmaster, the chairman of the governing body of the Imperial College, the guests were received by Mr. Herbert Wright, the chairman of the Executive Committee. Sir Dugald Clerk, as Prime Warden of the Goldsmiths' Company, delivered the building to Mr. Wright, representing the governing body of the Imperial College, and to Mr. Walter T. Prideaux, representing the delegacy of the City and Guilds (Engineering) College. The Duke of York, in declaring the building open, made a graceful reference to the interest which his grandfather, the late King Edward VII., had always shown in technical education. The late King, then Prince of Wales, laid the foundation column of the original City and Guilds College building in 1881 and became president of the City and Guilds Institute. Three years later he opened the buildings, declaring that the college represented one of the most cherished objects his lamented father (the Prince Consort) had in view. Finally, in 1909, towards the end of his reign, King Edward laid the foundation stone of the new Royal School of Mines, adjoining the engineering extension and also forming part of the Imperial College. Throughout his life his interest in technical education, inspired by the example of his father, was sustained and enthusiastic, and he took an active part in establishing many of the institutions at South Kensington which were rendered possible by the success of the 1851 Exhibition.

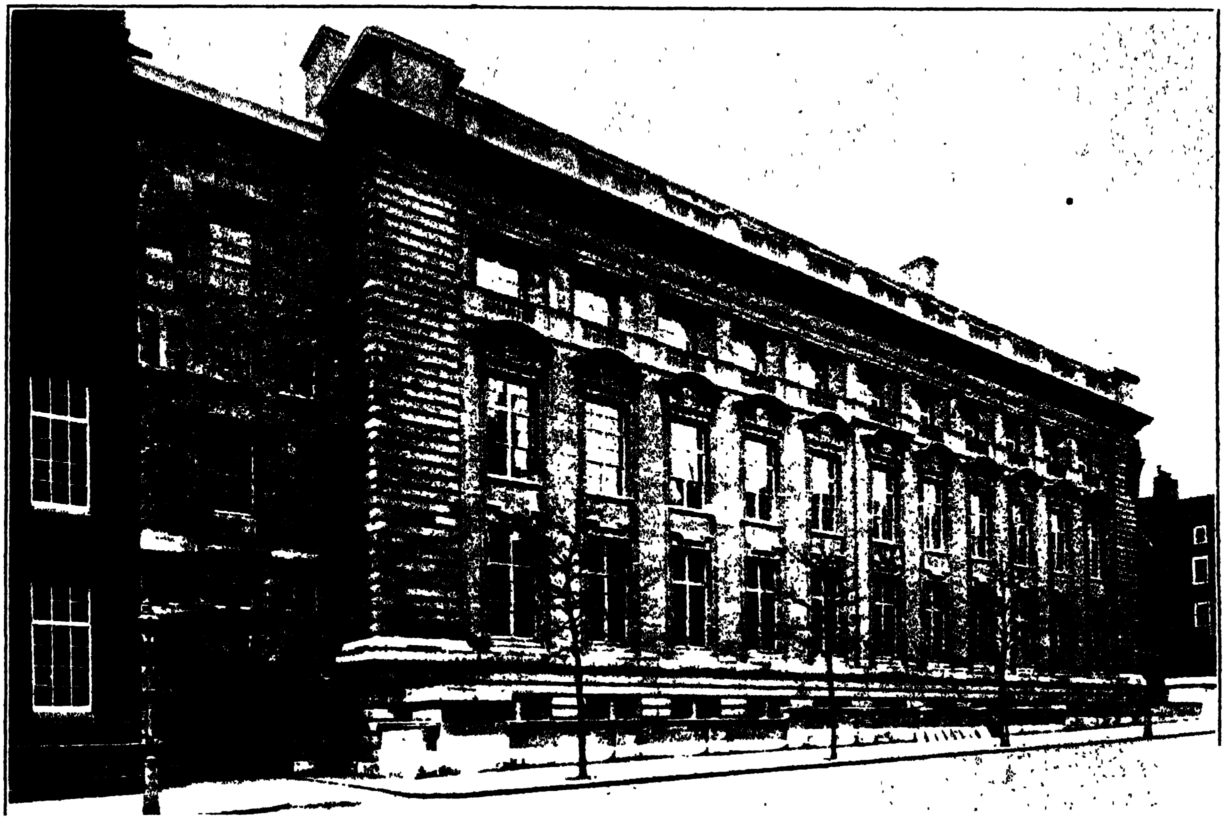

FIG. 2. The front, facing Exhibition Road, of the Goldsmiths' Company's Engineering Extension of the City and Guilds (Engineering) College.

The completion of this great undertaking, which places London in the leading position it should occupy in engineering education and research, provides an appropriate occasion for expressing appreciation of the work of the City Guilds in the promotion of technical education. Their munificence was enlisted in the earliest days of the movement and has not been restricted to London. Mr. C. T. Millis, the historian of technical education, states that the total grants of the City companies to the City and Guilds Institute amounted to the end of 1924 to 1,122,994*l.*, the Goldsmiths' Company heading the list with total grants of 204,523*l.*, followed by the Clothworkers', the Fishmongers' and the Mercers' Companies. Adding contributions to other institutions, including the Universities of Leeds and Sheffield, and the East London College, he estimates that the total amount expended by the companies must have exceeded 2,000,000*l.*

Naturally, the original schemes for promoting technical education were somewhat nebulous and have suffered modification in course of time. For example, the college at South Kensington, now dedicated to the training of engineers, was originally intended for the training of teachers in diverse crafts and industries. With the lapse of time also, the Government

and other public authorities have accepted an increasing responsibility for the maintenance of technical institutions; and the companies, relatively impoverished by the War and confronted by many other urgent calls for financial assistance, have shown a tendency to restrict their educational expenditure. One of the unfortunate results of this economy has been the recent closing of the Finsbury Technical College.

There is a desire also on the part of some of the companies to restrict their interest in technical education to the crafts represented by the respective companies; thus, the Clothworkers' Company has subsidised the textile department of the University of Leeds by a capital sum of 220,000*l*. and an annual grant of 4000*l*.; the Drapers' Company has devoted 20,000*l*. to scholarships for the textile industries; and the Leathersellers' Company have expended more than 20,000*l*. for a building for the Leather Tanning College.

In the early days of the technical education movement, a strong feeling was expressed by Huxley and others that part of the wealth of the city companies could be used to great advantage for the assistance of technical education. The educational deficiencies of the British workman were the first object of solicitude, and the provision of purely craft training still retains an important place in schemes of technical education. Developments in engineering, in the use of electricity, and in many other industries based on science, brought a demand for more specialised training, a demand which, in respect of civil, mechanical and electrical engineering, has been admirably met by the City and Guilds (Engineering) College.

The College has been loyally served by many distinguished professors and instructors and has rigorously maintained a high efficiency in all its work. No college can be trusted more implicitly to ensure proper standards of education and training in the award of degrees and diplomas. The College has sent out a large number of well-trained engineers to all parts of the world, and the Duke of York was well advised that he may expect to meet many City and Guilds men during his forthcoming Imperial tour. It will afford great satisfaction to all friends of engineering education that the College, thanks mainly to the generosity of the Goldsmiths' Company, has acquired this important addition to its equipment.

Obituary.

MR. G. W. LAMPLUGH, F.R.S.

BY the death of George William Lamplugh on October 9, British geology has lost one of its ablest exponents. Born at Driffield on April 8, 1859, he was educated at private schools, but spent the latter part of his boyhood at Bridlington, where the absorbing interest of the Yorkshire coast stimulated his natural bent for geology. Here arose a question, the answer to which was to determine the course of his future life. He had actually embarked upon a commercial career with geological work as a recreation. On one hand lay lucrative posts with the possibility of affluence; on the other, scientific research with a small competence. He considered the matter with characteristic deliberation; the possibility of affluence appealed to him not at all; he decided in favour of a life of research as soon as he was satisfied that the competence, if small, would suffice for his modest needs. In 1892 he joined the staff of the Geological Survey.

Lamplugh's first paper was published in the *Geological Magazine* in 1878 when he was nineteen years of age. In this and several papers which followed in the next few years, he described the sequence of beds which constitute the glacial drift of the Yorkshire coast, and the occurrence of marine shells, more or less fragmentary, in them. He noted also the drawn-out remains of a pond deposit crowded with the fresh-water shell *Limnæa peregra*, which occurred as lenticles in the boulder clay. At that time marine shells in the glacial drift were held by many to betoken submergence. Lamplugh then, as always, formed his own conclusions. Of the Bridlington Crag he writes that it is "probable that its great thickness and amassed appearance may have been due to the accumulating power of a huge mass of ice, which, grounding (and not, as with the smaller bergs, merely grating) on a soft bottom, would slowly continue its forward course for some distance . . . and might push before it a constantly increasing mass of sand and shells"; and again: "the movement of ice at one time on a soft sea-bottom and, at another, over the silty bed of a pond, has produced precisely similar effects." More than thirty years later I was with him and shared his excitement on seeing the process of transportation he had pictured, actually in operation in Spitsbergen.

The more important part of Lamplugh's work in those early years lay, however, in his study of the Speeton series and of his comparison of it with the Tealby series of Lincolnshire. He approached the subject from a thoroughly scientific point of view, bringing to bear an intimate knowledge of the fossils, acquired apparently and not taught, as well as detailed field-work. One of the results was to show "that in Lincolnshire, as in Yorkshire, the various species of belemnites present in the rocks afford the most natural and convenient means for classifying the strata; but that the well-defined zones which they form do not always coincide with the lithological divisions." This work attracted the attention of Prof. Alexis Pavlow, of the University of Moscow, and led to a joint paper on the correlation of the Upper Jurassic and Lower Cretaceous horizons of Speeton with their equivalents in Russia and other parts of Europe.

In 1892, as a member of the staff of the Geological Survey, Lamplugh commenced official duties which were to occupy nearly all the remainder of his life. He was entrusted soon after his appointment with the geological surveying of the Isle of Man. Except for a few weeks, during which I accompanied him for the purpose of initiating him in survey methods, he accomplished this great work single-handed. The range of problems which confronted him was prodigious, including as it did the sequence and structures of the older palæozoic rocks, the mapping of the newer palæozoic rocks and of the Trias, the great suite of igneous rocks, both contemporaneous and intrusive, an extraordinary development of glacial deposits, and lastly, mining developments that had once been of much importance. Some of

these lay outside the scope of his previous experience, but on all he brought to bear a judgment founded on the deliberate and exhaustive consideration of a problem from every point of view that was characteristic of him. Incidentally, I am reminded that we disagreed on the interpretation of the small tract we mapped together. I thought that certain structures in the volcanic rocks of Scarlet Point might be attributed to the turmoil of the eruption. He took the view that they were due to subsequent overthrusting. Which was right I do not know. The Isle of Man occupied him for five years. His memoir upon it, with its wealth of records and of original observations, takes rank as a classic in modern geology.

In 1901 Lamplugh was placed, as a district geologist, in charge of the Irish branch of the Geological Survey. He remained in Dublin until that branch was transferred to an Irish Department in 1905, and during his stay took part in the mapping of the country round Dublin, Belfast, Cork, and Limerick, turning his experience of glacial phenomena to great advantage. On his return to England he served as district geologist for the Midland district and afterwards for North Wales. Administrative duties took up much of his time, but he contributed to and edited several memoirs. Later on he was engaged in surveying part of the Wealden area and became concerned with the borings which were then being made to prove the extent of the Kent coal-field. The records of the boreholes were obtainable only under much difficulty, and many of them until they were interpreted by him were unintelligible. They revealed developments of the Secondary strata that differed from any known exposures, and when accompanied by the palæontological observations made by his colleague Dr. Kitchin, threw a new light on the Secondary geology of southern England. In 1903, with the late J. F. Walker, he wrote "On a Fossiliferous Band at the top of the Lower Greensand near Leighton Buzzard." The conclusions formed were not accepted by palæontologists, on the ground that the fossils were characteristic of a higher stratigraphical horizon and could not be in place. The beds, it was argued, must have been inverted, presumably by glacial agency. Lamplugh's last paper, in the *Quarterly Journal of the Geological Society*, in 1922, was devoted to a detailed account of all the sections in which the band had been recognised. He showed that the sequence originally described by himself and Walker has invariably held good in every successive exposure and over a large area. He did not regard the palæontological evidence as conclusive, and considered the suggestion of inversion to be untenable.

It was Lamplugh's desire to continue his work on the Lower Cretaceous rocks after his retirement from the Geological Survey in 1920, but it was not long before failing health rendered it impossible. In 1914 Lamplugh had been appointed assistant director for England and Wales. He held the post until his retirement. Never could there have been a more loyal colleague than he was to me.

Lamplugh loved travelling, but always with the view of increasing his geological experience. In 1884 he visited the Eastern and Central States of North America, Vancouver, and Alaska, and went southwards to the Mexican border and as far as New Orleans. In 1893 he saw the Grand Cañon of the Colorado, and in 1897 attended a British Association excursion to Vancouver. In 1905 he made a systematic examination of the gorge of the Zambezi, below the falls. "It is difficult to believe," he writes, "that the fissure into which the river is so suddenly precipitated has been formed gradually by the action of the river itself, and not by some great convulsion during which the very crust of the earth was rent." He was able, nevertheless, to find conclusive proof that the gorge was due to the erosive action of water as the river gnawed its way back into the heart of the continent, a view that had been put forward by Molyneux. In 1910 he attended the International Geological Congress at Stockholm and took part in an excursion to Spitsbergen. There, under the leadership of Baron De Geer, we were shown not only a magnificent development of Tertiary, Secondary, and Upper Palæozoic rocks, but also shelly drift in the process of manufacture. His last trip was to Australia, for the meeting of the British Association in 1914.

Lamplugh received several honours, but, if I may say so without breach of confidence, declined some through a somewhat over-sensitive modesty. In 1891 he was awarded by the Geological Society a half of the Lyell fund in recognition of his work on the Yorkshire coast, and in 1901 he received the Bigsby medal as an acknowledgment of the value of his researches on the Speeton series. In 1925 he was awarded the Wollaston medal, the highest honour in the bestowal of the society. He became a fellow of the Geological Society in 1890, served several times on the council, partly as vice-president, and was president in 1918–20. He was elected to the Royal Society in 1905, and served on the council in 1914–16. He was for a time secretary of Section C of the British Association, and was president of the section in 1906. He was past-president of the Yorkshire Naturalists' Union, of the Hull Geological Society, and of the Hertfordshire Natural History Society, and an honorary member of several other societies.

Lamplugh's work was characterised by thoroughness of observation and by his habit of devoting prolonged consideration to a subject before forming conclusions. Though an original thinker, he never advanced a view that he was not able to support by sound evidence. He was a wide reader, mainly of a class of literature that makes no appeal to the multitude, and had acquired a critical judgment of style. In his own writing he took infinite pains to express his exact meaning, and expected this of others. As a colleague he was loyal; as a friend, lovable. A. STRAHAN.

DR. PAUL KAMMERER.

THE family Kammerer is of Saxon descent. The ancestors migrated first to Transylvania, and from there to Lower Austria and Vienna. Here Paul Kammerer's father erected a manufactory for scientific instruments. Paul Kammerer was born on August 18, 1880, studied at the University of Vienna in 1899–1904, took the degree of doctor in philosophy on June 23, 1904, and got the *venia legendi* for experimental morphology at the philosophical faculty of this same University. Having been a member of the staff

of the Biologische Versuchsanstalt since its beginning (1902), he was given the post of state-adjoint when thi: institution was taken over by the Viennese Academy o Sciences, and remained in this post from 1914 until 1923 He then applied for his pension, and undertook lecturing tours to many European states, and twice to Nortl America. Last year he was called to Moscow, where he was appointed to a chair in the State University and was entrusted with the erection of a laboratory for the biological department of the Moscow Academy However, in a moment of mental depression, he deemed himself not able to undertake this task and shot himself on the Hochschneeberg, near Vienna, on September 23.

Kammerer's work will without doubt secure him a lasting place in the memory of biologists, even if some points in his papers require further elucidation and are still open to criticism. His scientific investigations were mostly published in the *Archiv. für Entwicklungsmechanik*. They apply to experimental modification of animal form, colour, and function, to their behaviour in subsequent generations, to regeneration and age, symbiosis, and the crossing of species. Kammerer's first studies were in pœcilogony or the modifiability of gestation in the same species For his discoveries of this phenomenon in *Salamandra atra* and *S. maculosa* he was awarded the Sömmering medal for the year 1909 by the Senckenbergische Naturforschende Gesellschaft in Frankfort-on-Maine. The president of this society, Prof. A. Knoblauch, had himself undertaken the task of repeating some of these experiments (*Zool. Garten*, 45, n. 11, 12, 1904). Kammerer later extended his studies on pœcilogony to Hyla, Alytes (1906), Proteus (1912), and Lacerta (1910, 1925). Summarising the results, we may say that external factors, especially temperature and moisture, may modify the reproductive process in amphibians and reptiles in such a manner as to shift it in the direction taken by other species living in localities with a corresponding climate.

For many years Kammerer was occupied with the adaptation of amphibians, reptiles, and other animals to the colour of the background. He showed that *Salamandra maculosa* is capable of changing its colour after metamorphosis according to the colour of light reaching its eyes (1913), and that this slow morphological colour-change evolves from the quick physiological colour-change in the larvæ (1922). These results, often doubted, have been confirmed from different quarters (see Przibram a. Dembowski, 1922 ; *A. f. Entwm.* 50, 108 ; Biedermann in *Ergebnisse der Biologie*, 1, 1925 ; MacBride, *Proc. Zool. Soc. London*, 3, 983, 1925). Succeeding several times in raising Proteus, Kammerer had the opportunity, in his experiments on pœcilogony and colour-change, to test the dependence of the eye on light, a question to which he was able to give a positive answer (1912). He also proved the restoration of the power of vision (*Pflüger's Archiv.*, 1913). The possibility that these specimens with enlarged eyes may have been mutations was later discarded even by the originator of this explanation, Jacques Loeb, in his last book, " The Organism as a Whole " (1916), as highly improbable.

Kammerer exhibited his most remarkable specimens to the Linnean Society of London, and in Cambridge, during the year 1923. The honour he was shown during his visit to England was one of his most pleasant recollections. Even if Kammerer's proof of the inheritance of acquired characteristics may be held to require confirmation, it is not too much to say that no one else has made greater advance towards the solution of this fundamental question, and that his numerous papers include several very important contributions to biological science. Results confirmatory of his views have been obtained by Dürkhen (1924) and Heslop Harrison (1925), who worked entirely independently of Kammerer, and on totally different animals. Kammerer's last paper on the origin of the island-races of Lacerta in the Adriatic (1926) is one of the finest contributions to the theory of evolution which has appeared since Darwin.

PROF. ALEXANDER GUTBIER, Rector of the University of Jena, died suddenly on October 4 at the age of fifty years. We learn from the *Chemiker Zeitung* that Prof. Gutbier was a native of Leipzig. He became professor of chemistry at the Technische Hochschule at Stuttgart in 1912, and ten years later he succeeded Prof. Knorr at Jena, where he built up an efficient modern chemical institute, in which numerous valuable researches in analytical and colloid chemistry were carried out. His own publications dealt chiefly with investigations of tellurium, selenium, and the noble metals, with atomic weight determinations, and with colloidal metals and protective colloids. He also published several works on practical chemistry.

WE regret to announce the following deaths :

His Honour Sir John Bucknill, Puisne Judge of the Patna High Court, formerly editor of the *Journal of the South African Ornithologists' Union* and author of works on the birds of Surrey and of Cyprus, on October 5, aged fifty-three years.

Prof. J. D. F. Gilchrist, professor of zoology in the University of Cape Town, and president in 1922 of the South African Association for the Advancement of Science, aged sixty years.

Mr. George Lewis, who devoted the greater part of his life to the study of the Coleoptera, and particularly the Histeridæ, visiting China, Japan, Ceylon, and Algiers, on September 5, aged eighty-seven years.

M. Edouard Naville, fellow of King's College, London, and a foreign associate of the Institute of France, listinguished for his archæological work in Egypt, on October 17, aged eighty-two years.

Mr. Washington A. Roebling, engineer and builder of the Brooklyn Bridge, on July 21, aged eighty-nine ars.

Mr. Oberlin Smith, an authority on the pressing and stamping of metals, and a past president of the American Institute of Mechanical Engineers, on July 8, aged eighty-six years.

Mr. Charles Turner, for many years principal of the Manchester School of Pharmacy, who made many contributions to our knowledge of the freshwater algæ, on September 10, aged sixty-two years.

News and Views.

THE address given by the Secretary of State for the Dominions and Colonies at the fourth session of the Imperial Conference is a further revelation of the growing popularity of scientific research as a theme for statesmen's utterances and an indication of their lost faith in ephemeral economic theories. The greater part of Mr. Amery's discourse was devoted to a survey of the problems of Empire development which await investigation and the steps which must be taken towards their solution. He announced that a very small committee has been appointed to consider what existing research organisations can do for the improvement of the production, transportation, and storage of Empire food-stuffs and raw materials required for manufacturers, what further support is necessary to make their work more effective, and what additional institutions are required He reminded the Empire premiers that the standard of work of the agricultural departments of the Colonies and of the agricultural staffs of various private companies is no credit to the Empire, and that there is need for greater support for such institutions as the Imperial College of Tropical Agriculture at Trinidad and the Amani Institute in Tanganyika, to act as training centres for agricultural staffs and as an inspiration to all agricultural departments in the tropics. Out of the fund at the disposal of the Empire Marketing Board, further support has been given to assist the work of the Low Temperature Research Station at Cambridge, probably a grant will be made to the Fruit Research Station at East Malling, and the Imperial Bureau of Entomology has been allocated a contribution to enable it to set up a special laboratory for the breeding of beneficial parasites and their distribution as required to all parts of the Empire Mr Amery expressed his belief that incalculable results will follow the expenditure of money derived from a fund which can be freely allocated to the vital needs of research on Empire problems

MR AMERY might have reminded the Empire delegates that the British Empire is on its defence in the matter of scientific research Great Britain has assumed the responsibility for the development of the illimitable potential resources of a large part of the world's surface It possesses some of the finest scientific investigators in the world, but hitherto our statesmen have not performed the essential function of catalysts in bringing the knowledge of the latter to bear upon the problems of the former. Several other colonial powers, notably France, Belgium, and Holland, have given more scope and encouragement to the work of their scientific researchers than Great Britain, and a former colonial power, Germany, in the comparatively few years in which it was interested in colonial development, built up a corps of research workers in every field of scientific endeavour and a chain of scientific institutions which still commands the respect of the world. Mr Amery's speech, it is hoped, will imbue the Empire premiers and other representatives with the same enthusiasm and appreciation for the need to apply science to the problems facing them as he and his able Under-Secretary, Mr. Ormsby-Gore, already possess. Elsewhere in this issue of NATURE appears the first of two articles referring to Mr. Ormsby-Gore's recently published report on West Africa, a report which can be commended to the Empire delegates for their most careful study. Therein is set forth in some detail the avoidable waste which occurs in this part of the British Empire in connexion with the production, storage, and transport of the products of the tropics, the avoidable waste of human endeavour and human life, the toll taken by insect pests on human beings, domestic stock and plants, the non-utilisation of natural resources, and the tremendous expansion of trade which would result if these problems were investigated by competent scientific workers

BOTH Mr. Amery and Mr Ormsby-Gore emphasise the need for co-ordination and dissemination of the knowledge accumulated by scientific investigators, to the end that science shall be applied generally throughout the Empire to the common problems of development But neither of them realises, apparently, that the present machinery of administration is inadequate to this all-important task. Last year the Prime Minister raised great hopes by the announcement of the creation of a body charged with the responsibility of initiating research into imperial problems. These hopes have not been realised The new body, the Civil Research Committee, was modelled on the Imperial Defence Committee · its deliberations are characterised by the utmost secrecy : even its findings and its reports on subjects of general interest are not made available to the public, and it has been overloaded with irrelevant problems No scientific man was appointed to the Committee; its work has been farmed out to *ad hoc* sub-committees possessing no powers and commanding no funds It bears no resemblance to the body suggested by Mr. Baldwin, and later by Lord Balfour during the House of Lords debate on the Report of the East Africa Commission the Report which gave such prominence to the need for scientific research in Empire development. Perhaps Mr. Garvin's demand in the *Observer* of October 24 for "a Great General Staff for . . . the systematic accumulation and arrangement of knowledge—a greater Domesday Book showing clearly what works, enterprises, and scientific institutions are required to make the most of the resources of the Empire in every part," may have the desired effect. Mr. Garvin might have added that it is imperative that this general staff should be composed mainly of those who have been trained in the methods of science, appreciate the aims of science, and understand its language.

IN his inaugural address to the Institution of Electrical Engineers, delivered on October 21, Dr. W H. Eccles presented a review of the present-day position of electrical industry in Great Britain, both in relation to its development and to the state of the industry in other countries. The conclusions he drew are in some respects unfavourable to British practice and he suggested certain necessary lines of

advance. Dealing first with electric supply, Dr. Eccles finds for the five countries, the United States, Canada, Germany, France, and Great Britain, taking only the larger undertakings which had collectively an output of 2000 million units or more in 1925, that the output in units per kilowatt of plant installed varied from 4500 for Canada to 2110 for Great Britain and 1820 for France. The low efficiency of the British undertakings is attributed to the smallness of the machines and stations and the rigid separation of the undertakings. The chief cause of the slow development in Great Britain appears to be the neglect of the principle of intercommunication. With a few large generating stations between which there is thorough intercommunication, each in turn can take the peak of the other's load. The size of each station need not then be so great and the efficiency of the whole undertaking is enhanced. In Germany there are four great zones the power of which varies from 400,000 kilowatts to 1,500,000 kilowatts, and these zones are now being connected into one national system Similarly in France, the United States and Italy, but in Britain the largest plant capacity is that of the London Power Company, which is about 250,000 kilowatts. The use of electricity on railways was discussed, and it was pointed out that the electrification of main lines may not lower the cost of working; its chief advantage will lie in providing national intercommunication networks and in extending electrical facilities into areas which could not otherwise be made suitable for modern factories.

It is satisfactory to note the growth in the use of electricity in the chemical and metallurgical industries pointed out by Dr. Eccles. There is a marked rise in the production of aluminium. In the case of sodium, we imported from Norway 41,800*l*. worth and exported 14,000*l* worth in 1924; in 1925 the figures are 17,000*l* for import and 28,000*l*. for export. Increases are also taking place in the production of ammonium sulphate and magnesium. Electricity in agriculture is backward in Britain. In Germany, 90 per cent. of the farms have an electric supply; in America there are 700,000 farms using electricity, but in Britain only 400 farms, *i e* 0·8 per cent., are supplied with electricity. One of the brightest points in the address refers to the export of submarine cable for telegraphy and telephony. The new type of cable loaded with permalloy (American) or mumetal (English) has rendered possible the transmission across the Atlantic of 2500 letters a minute. Of the 12,000 miles of this cable which has been ordered, all but one length is from British manufacturers. The positions of the telephone, telegraph and radio manufacture and services also come under review, and two appendices give details of the imports and exports of electrical apparatus and machinery for 1912, 1913, 1923, 1924 and 1925. The third appendix gives the export figures for the United States, Great Britain, and Germany for 1913, 1924 and 1925.

Perhaps the most significant fact brought forward by Dr. Eccles in his address was that referring to research and invention. Dr. Eccles has obtained statistics of the patents granted in America, Germany, and Great Britain, the three principal electrical countries. The native inventors were in the case of America 89·2 per cent. of the whole number; in Germany 77 per cent.; and in Britain, 57 per cent. Of the electrical patents in America, 13·5 per cent. are of foreign origin, and in Germany the figure is 26 per cent.; in Britain 59 per cent. are foreign. This means that "in this intellectual side of industry we have a big adverse trade balance, for which, doubtless, we pay a correspondingly large annual tribute in money." Dr. Eccles insists again upon the folly of starving technical education and research, which must both be considerably extended, unless we are to "pay other nations to do the necessary brain work for us."

On Monday last, October 25, a commercial high-speed radio telegraph service, utilising the principles of short-wave beam transmission and reception, was opened between Great Britain and Canada. This event followed the satisfactory completion of a preliminary seven days' test conducted by the General Post Office, during which the average speed of signalling was 600 letters per minute simultaneously in each direction. In England the transmitting station is situated near Bodmin and the receiving station near Bridgwater, while the corresponding stations in Canada are in the neighbourhood of Montreal. The stations at each end of this communication channel are similar in design, and they utilise a straight row of vertical aerials located in front of a similar row of wires forming the reflector, the resulting radiation is thus concentrated in the form of a beam directed towards the receiver. The wave-length employed is in the neighbourhood of 100 metres, and while the transmitting power is only 20 kilowatts, the effect of the reflectors at each end is to give a very much greater received signal strength than is obtainable with the usual type of aerial arrangement. Among the advantages possessed by this beam system for long-distance radio communication are the comparatively low capital cost of erection, economy of maintenance, freedom from atmospheric interference, and the possibility of very high signalling speeds. The combination of these advantages should result in the handling of a large volume of traffic at a cheap rate. The service now opened is the first of four similar beam circuits which will link Great Britain directly with Canada, South Africa, India and Australia. The completion of these 'point-to-point' services will, together with the high-power 'world-wide' station already in operation at Rugby, place Great Britain in the forefront of commercial radio practice.

The news that Messrs. Brunner, Mond and Co., Ltd, Nobel Industries, Ltd., the British Dyestuffs Corporation, Ltd, and the United Alkali Co., Ltd. are about to fuse their interests and form a huge chemical combination on the lines of the German Dye Trust, was not entirely unexpected, owing to recent activity in the shares of some of these companies. Rumour had mated Brunner, Mond and Co. with the

Dyestuffs Corporation, but the adhesion of the other two companies to the alliance was not anticipated. Only in July last, Lord Ashfield told his shareholders that it was more than probable that the Corporation would co-operate, and possibly consolidate, with other large chemical undertakings. On October 22 the directors of the four companies announced in the Press the proposed formation of a new company to acquire their shares and to develop their businesses and resources on broad Imperial lines. Nobel Industries already controls thirty companies largely, but not exclusively, engaged in the manufacture of explosives; and Brunner, Mond and Co. has a controlling interest in such important undertakings as Synthetic Ammonia and Nitrates, Ltd., and the Castner-Kellner Alkali Co., Ltd. The aggregate authorised capital of the associating companies is 47,500,000*l*., and their issued share capital is 38,225,714*l*. On October 22 the market value of the ordinary and deferred shares (24,918,753*l*.) was more than 40,000,000*l*.

SIR ALFRED MOND will be chairman of the new holding company, and Sir Harry McGowan, chairman of Nobel Industries, will be its president and vice-chairman. In a statement issued to the Press, Sir Alfred Mond emphasised the national and Imperial aspect of the combination. The existence of similar organisations on the Continent and in the United States has compelled the British manufacturers to combine their forces and present a united front to the rest of the world. The identity of the individual companies is not to be destroyed, but the board of the new company will act as a supervisory and connecting link between them, in finance and in policy. Modern mergers are not made to create monopolies or to inflate prices, but to achieve economy in effort and costs, and to provide insurance against market fluctuations. A combination such as that now contemplated will be able to finance, develop and explore many new potentialities in chemical industry, and so keep Great Britain in the front rank both as regards national safety and the supply of chemical products to a vast number of industries that depend upon chemistry. Few will disagree with Sir Alfred's remarks, although he did not mention certain disadvantages that sometimes result from the concentration of money and power in the hands of small groups.

ON October 22 a destructive earthquake occurred in the district of Alexandropol (or Leninakan) in Armenia. Three hundred persons were killed and twelve villages were badly damaged, but as communications in many places are interrupted, the full extent of the disaster is as yet unknown. Alexandropol is one of the most active earthquake-centres in the territory between the Black Sea and the Caspian, though it is surpassed in the frequency and severity of its earthquakes by two other centres, near Tiflis and Chemakha. On the same day three earthquakes were felt in California, only one of which was strong enough to cause slight damage. The interest of the shocks is due to their possible connexion with the San Andreas rift and the earthquake of 1906. Their centre was evidently some distance, perhaps a hundred miles, to the south of San Francisco.

SHORTLY after the announcement of the recent discovery of a skull of Pithecanthropus type at Trinil in Java (see NATURE, October 2, p. 491) private information from Washington made it appear likely that its importance had been overrated, and that the skull would not provide the data relating to the facial portion which anthropologists especially desired. Later news had not confirmed the first announcement that the skull was complete. It now appears that the find is not a skull but a cast in spongy stone of volcanic origin. Its appearance indicates that volcanic ash settled round the skull and, in time, the bone disappeared. The cast shows the frontal bone, the right and two-thirds of the left parietal bones, the upper part of the right and a little of the left temporal bones, and the supra-orbital ridge. It must be noted that the cast was not obtained *in situ* but from natives by whom it had been unearthed, so that the geological conditions of its discovery must remain in doubt. It is not easy to understand how a cast made in such circumstances, which normally would give the internal and not the external form, could show the characteristic supra-orbital ridge; but for the re-solution of this and other questions, the arrival of photographs must be awaited.

THE problem of peopling Australia is discussed by Mr. J. de V. Loder in an article in the October issue of the *Empire Review*. He quotes the late Lord Leverhulme's advocacy of black labour in tropical Australia as an opinion based solely on economic grounds, without consideration of the deeper sociological issues involved It is not merely the desirability of excluding cheap labour that would undercut the whites, but the danger of introducing social, political, and religious ideals unacceptable to white civilisation, that are the real arguments in favour of the 'white Australia' policy. The suitability of the tropics for permanent white settlement by an increasing population has not been proved, and cannot be proved except by experiment. Modern science has done much to solve the problem, but there still remains a doubt as to the possibility of racial acclimatisation on a large scale. Mr Loder thinks that the policy of keeping Australia for the white races is a justifiable gamble, and sees possibilities for white settlement in the hot dry regions of the north which are suited for sheep-ranching. In the hot wet regions he is less hopeful, and unfortunately for Australia these are the really productive and valuable parts of tropical Australia. In any event, there is little hope of attracting emigrants to such lands until the more temperate parts of Australia are filled.

ON October 9, H.R.H. the Duke of York opened the new X-ray Department in the Royal Infirmary of Edinburgh, which has just been completed at a cost of 52,000*l*. The new Department, which is about 160 feet long by 60 feet wide, contains a sunk basement and two floors. The basement contains a large motor generator supplying alternating current to the whole

of the Department, together with X-ray transformers, main control boards, and a workshop. Thus there is no moving machinery with its attendant rumble on the ground floor where all the X-ray rooms are situated (radiographic, screening and treatment) The deep therapy (250,000 volts) and superficial therapy sets are valve rectified. There are also a lecture and demonstrating hall, dark rooms, waiting and examination rooms, together with private rooms for the staff. On the upper floor, accommodation is provided for electrical and massage treatment, remedial exercises, radium treatment, and artificial sunlight treatment. Some features of the new building are designed with the view of furnishing the fullest protection for the operators against constant exposure to the X-rays. The walls are constructed of concrete slabs containing barium sulphate These afford protection equivalent to 5 mm of lead, as measured by the National Physical Laboratory, which has also inspected the completed Department. From the point of view of the X-ray Protection Committee's recommendations, the new Department is almost ideal, and it should prove a worthy model for future X ray departments The University has instituted a diploma, D R Edin, for which a candidate will take a suitable course in physics at the University and carry out practical work in the infirmary, the course extending over about a year.

At the thirtieth annual meeting and annual foray of the British Mycological Society, held at Hereford on Sept. 27-Oct 2, Dr. G. H Pethybridge, president, gave an address on "Mycology and Plant Pathology." The British Mycological Society to some extent may be looked upon as an expansion and continuation of the activities of the Woolhope Naturalists' Field Club, which originated fungus forays more than half a century ago. The fungus flora of Britain is now fairly well worked out, and more attention might be paid to the ecology and bionomics of fungi. Tracing the development of plant pathology in Britain, we find that at one time mycology was regarded as of little or no importance in relation to the causation of plant diseases; fungi occurring in connexion with disease were regarded as the *result* of such disease, not the cause of it. Disease in plants is the consequence of disharmony between the plant and its environment. A parasite, if present, is part of the environment considered in its widest sense, and it must not be forgotten that both host and parasite are to some extent variable or unstable and that the fluctuating factors of the environment may influence the parasite as well as the host. However, the parasite—most frequently a fungus—is often the most important factor in disease production. Plant pathology in Great Britain is of comparatively recent growth. The possibility of the introduction of the Colorado beetle occasioned the passing of the first Act of Parliament dealing with the protection of crops, it was extended and amplified as the Destructive Insects and Pests Act in 1907 on account of the spread of the American gooseberry mildew. A small *ad hoc* inspectorate was then inaugurated by the Board of Agriculture. The greatest stimulus to the development of plant pathology has followed from the provision by the State of greatly increased funds through the Development and Roads Improvement Funds Acts 1909 and 1910, and afterwards through the Corn Production Acts (Repeal) Act of 1921.

An appointment to a Beit Memorial Fellowship, of the annual value of 1000*l.* and tenable for five years, is to be made for whole-time research in tropical medicine; allowances will be given for travelling and laboratory expenses. Applicants must be of European descent and of degree standing in a university of the British Empire approved by the Trustees of the fund, and must state their proposed subject of research. Forms of application, obtainable from the honorary secretary of the fund, Sir James K. Fowler, at 35 Clarges Street, London, W.1, are to be returned on or by February 1 next. This fellowship is a noteworthy addition to the opportunities for research now available, and there is no doubt that it will lead to important contributions to our knowledge of health and disease in the tropics.

The seventeenth annual Exhibition of Electrical, Optical and other Physical Apparatus arranged by the Physical and the Optical Societies will be held at the Imperial College of Science and Technology on January 4-6 It has been decided again to include, in addition to the well-established Trade Section, a Research and Experimental Section similar to that successfully initiated in last January The groups in this section comprise (*a*) Exhibits illustrating the results of recent physical research and improvements in laboratory practice, (*b*) effective lecture experiments, (*c*) repetitions of famous historical experiments Offers of exhibits should be addressed to the Secretary of the Physical Society at the Imperial College of Science and Technology, South Kensington, S.W 7, not later than November 10

The People's League of Health, 12 Stratford Place, Oxford Street, London, W 1, has arranged two interesting series of lectures to be delivered during November and December at the rooms of the Medical Society of London, 11 Chandos Street, Cavendish Square, W 1. One series, on November 1, 8, 15, 22, 29, December 6, 13, and 20, deals with the mind in normal and abnormal subjects, and the lecturers are Dr E Mapother, Dr. E. D. Macnamara, Dr. N. Hobhouse, Dr H. Crichton-Miller, Sir Maurice Craig, Sir Robert Armstrong-Jones, Dr. W A. Potts, and Dr. A. F. Tredgold. The other series, on November 3, 10, 17, 24, December 1, 8, and 15, is on various aspects of diet and foods, and the lecturers are Dr. H Campbell, Prof. Leonard Hill, Prof. Winifred Cullis, Prof. W. E. Dixon, Dr. J. Lewis Rosedale, Prof. Hugh MacLean, and Dr. R. Ll. J. Llewellyn. The lecture hour is 6 P.M.

A licence under Section 20 of the Companies (Consolidation) Act, 1908, has now been issued by the Board of Trade to the Research Association of British Paint, Colour, and Varnish Manufacturers, which has been approved by the Department as complying with the conditions laid down in the Government scheme

for the encouragement of industrial research. The Secretary of this Association is Mr. J. B. Graham, 8 St Martin's Place, London, W.C.2.

IN the short notice of "Phototopography" by Mr. A. L. Higgins which appeared in NATURE of June 26, p. 889, it was stated that ground photographs had been used for surveys in Canada but not in other parts of the British Empire. The Surveyor-General of India points out that experiments with the photo-theodolite were carried out in India more than twenty-five years ago, and the method was utilised on the Mount Everest expedition. The ground photographs which are being taken this year in Kashmir will be utilised in conjunction with plane-table surveys. They will only cover a small area of the country. It was not the reviewer's intention to suggest that ground photo-surveying had not been tested in India or elsewhere, but that it had not been adopted for ordinary topographic surveys outside Canada.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in physics at the Royal Dental Hospital of London, School of Dental Surgery—The Dean of the School, Leicester Square, W.C.2 (November 1). A head of the department of Leather Trades of the Port Elizabeth Technical College, South Africa—G. H. Penney and Co., 23 Lime Street, E.C.3 (November 8). A head of the mechanical engineering department of the L.C.C. School of Engineering and Navigation, Poplar—The Education Officer, T.1.a., County Hall, Westminster Bridge, S.E.1 (November 8). A chemist for tobacco work under the Egyptian Government—The Chief Inspecting Engineer, Egyptian Government, 41 Tothill Street, S.W.1 (November 12). An assistant lecturer (man) on education at King's College—The Secretary, King's College, Strand, W.C.2 (November 26). A professor of archæology in the University of Edinburgh—The Secretary, University, Edinburgh (December 31). An assistant chief entomologist, an entomologist and a mycologist under the Egyptian Ministry of Agriculture—The Under-Secretary of State for Agriculture, Ministry of Agriculture, Cairo (January 1). An expert in pisciculture under the Egyptian Government—The Royal Egyptian Legation, 7 Charles Street, Berkeley Square, W.1. A lecturer in physics and electrical engineering at the Handsworth Technical School—The Principal, Handsworth Technical School, Goldshill Road, Handsworth, Birmingham. A head of the mining department of the Barnsley Technical and Mining School—The Principal, Harvey Institute, Barnsley. A technical officer in the air-worthiness department, Royal Aircraft Establishment, South Farnborough—The Chief Superintendent, R.A.E., South Farnborough, Hants, quoting A. 130).

Our Astronomical Column.

RELATIVITY AND THE DAYTON MILLER EXPERIMENTS.—The issue of the *Nineteenth Century* for October contains an article on this subject by Prof. H. Wildon Carr. The article is largely of a philosophical character and emphasises the great change that relativity has brought about in our outlook on the phenomena of the universe. Interesting parallels are drawn with the Copernican revolution, and with the birth of philosophy in ancient Greece. There is also an explanation of the theory in non-technical language. Incidentally, Prof. Carr gives 5000 miles per minute as the earth's orbital speed: it should be 1110.

Referring to the system of dynamics accepted by Newton, Prof. Carr says "It is now rejected as untrue in theory and useless in practice." This statement, however, needs qualification. The tables of the sun, moon, and planets that are still in use are based on pure Newtonian principles, save for an empirical increase in the motion of certain perihelia (adopted long before Einstein explained its cause) and an empirical term in the moon's motion (quite unconnected with Einstein). The most ardent relativist would not desire to supersede these tables, since the changes in them that would result from Einstein's law are absolutely inappreciable with our present means of observation.

The close of the paper deals with Dr. Dayton Miller's repetition of the Michelson-Morley experiment, but it describes him as still adhering to the theory of an ether-drag, which diminishes with increasing altitude. Dr. Miller made it fairly clear in his lecture at the Royal Institution some months ago that he no longer holds this view. He now considers that observations at all altitudes (including the original Michelson-Morley experiment) indicate an apparent change in the velocity of light depending on the sidereal time of observation. The change is only a small fraction of the orbital speed of the earth; it was suggested that the Lorentz-Fitzgerald contraction damps down the observable effect, but does not conceal it entirely. This tends to weaken the argument drawn by Prof. Carr for the non-existence of the ether, from the difficulties which he rightly puts forward as regards an ether-drag.

SOLAR ACTIVITY DURING 1925.—An account of solar observations made at the Astrophysical Observatory of Catania is published by G. A. Favaro in "L' attività del sole nell' anno 1925," in continuation of the series commenced in 1919. Observations for sunspots were made on 332 days in the year 1925, for faculæ 290 days, for prominences 104 days, and for the measurement of the height of the chromosphere on 140 days. Tables are given of the mean frequency of sunspots, faculæ, and prominences. Drawings also illustrate the chief disturbances of the year, the dates selected for sunspots being February 14, May 5, November 26, and December 27; those for prominences being February 24, June 17 and 18. The highest prominence recorded during 1925 occurred on February 24 with a maximum height of 211″, or about 153,000 km. The mean height of the chromosphere measured in the C line of hydrogen was 10″·9 or about 8000 km., the monthly means of the measures ranging from 10″·5 to 11″·7.

It is of interest to show in tabular form the rise of solar activity since the last spot minimum in 1923 as indicated by various observations.

Observation.	Place.	Year. 1923.	1924.	1925
Daily sunspot frequency (groups and single spots)	Catania	0·7	1·8	3·6
Wolfer's "Spot Numbers"	Zurich	5·8	16·7	41·6
Daily spot areas [1]	Greenwich	55	270	829
Days without spots	Greenwich	171	97	19

[1] Corrected for foreshortening, in millionths of the sun's visible surface

Research Items.

INDIAN ORIGINS.—An ingenious if highly speculative note by Mr. H. Bruce Hannah in the *Journal and Proceedings of the Asiatic Society of Bengal*, N.S., Vol. 21, No. 1, deals with the question of the approximate period of the Mahābhārata war and the ethnological affinities of the participants in it. According to the legend the war was fought between the Kūrūs and their cousins the Pāndavas. The concrete historical protagonists appear to have been the Kūrūs (Dasyūs and their followers) and the Pāncha-Janāh. The Pāncha-Janāh consisted of the Pūrūs or Pauravas, Yādūs or Yādavas, Tūrvaśas, Ānūs, and Drūhyūs—all mentioned in the Rig Veda. They were probably four communities of western Asia, namely, the Philistines, the Amorites of Yādai in Nāharin, broken Hittites, and a Phallus-worshipping people called "The People of the Pillar," of Heliopolis, in Deltaic Khem, who had been driven out by Rameses III. about 1156 B.C. These were the people responsible for the introduction into India of the divine names afterwards transmuted into Indra, Mitra, etc. They settled in the Punjab, where they found aborigines and a dominant race of dark white, or perhaps semi-mongoloid, stock. These latter were the representatives of a widely diffused ancient central Asiatic people known to the rosy-blond Aryanians as Dahyūs or Tokhs, and descendants of the Kūśa or "wolf-folk." They were not, however, uncivilised, and they dwelt in cities. Possibly the culture discovered at Mohenjo-Daro and Harappa and the civilisation of Susa discovered by de Morgan are vestiges of this civilisation. As a result of the struggle between the Dasyūs and the Pāncha-Janāh about 1000 B.C. in the Mahābhārata war, the Dasyūs or Kūrūs established themselves and acquired some of the culture of the Aryan Kshatriyās, evolving what has come to be known as Brāhmanism and caste. Further, it is suggested that about 4000 B.C. Dahyūs from central Asia penetrated to south India and, combining with the aborigines, founded the Dravidian race.

NEW AND LITTLE-KNOWN INSECTICIDES.—In the August issue of the *Annals of Applied Biology* (vol 13, No. 3) Messrs. F. Tattersfield, C. T. Gimingham, and H. M. Morris have a fourth contribution dealing with studies on insecticides. In the present instance they are more especially concerned with the insecticidal properties of plant materials, in the form of alcoholic extracts. Perhaps the most interesting plants with insecticidal properties are certain kinds used by natives of tropical countries as fish poisons. The roots and stems of White Haiari and the stems of Black Haiari (both species of Lonchocarpus from British Guiana), the roots of *Tephrosia toxicaria* and the leaves of *T. vogelii*, when tested as stomach poisons, all exert both a repellent and toxic action to caterpillars. The most toxic substance obtained from the Haiaris is shown to be identical with tubatoxin, the crystalline poison found in *Derris elliptica*. In the same journal Messrs. C. T. Gimingham, A. M. Massee, and F. Tattersfield discuss the toxicity of 3 : 5-dinitro-*o*-cresol and its sodium salt to the eggs of certain species of insects. The figures obtained show that these compounds have a very high toxicity to insect eggs. The 3 : 5-dinitro-*o*-cresol at concentrations ranging from 0·5 per cent. to 0·15 per cent. killed 80-82 per cent. of the eggs of the hop-damson aphis and did not injure the trees upon which the trials were carried out. These two compounds exercised a marked cleansing effect upon the bark, and it is evident, if further trials substantiate the results obtained, that such compounds afford considerable promise as winter sprays upon various fruit-trees.

LITERATURE OF SALMON FISHERIES.—In a paper recently prepared by Mr. W. J. M. Menzies (*Fisheries, Scotland, Salmon Fish.*, 1925, II. (Edinburgh and London: H.M. Stationery Office, 3*s*. 6*d*. net)) is given a general index to the reports and papers issued by the Fishery Board for Scotland on the subject of salmon fisheries for the years 1882-1924 inclusive. This has been arranged to contain an authors' index, a subject index, and a district index in which can be found all the published information about any particular district, river, or loch. Arranged as it is in these three divisions, the work should prove of great value

FOREST IN RELATION TO HUMUS.—Dr. W. H. Pearsall has recently reviewed (*Journ. of Ecology*, vol. 14, No 2, August 1926) a number of publications upon the Finnish forests; a comprehensive publication of similar nature upon the Swedish conifer forests and their relation to the different types of humus, by Henrik Hesselman (*Meddelanden från Statens Skogsforsöksanstalt*, Häfte 22, No 5), has also appeared. Different types of humus covering are distinguished, and attention is directed to the importance of the agencies preventing undue accumulation of leaf debris in the permanent forest The mobility of the nitrogen in the products of decay, during the changes undergone by vegetable remains in the humus layer, is suggested as a very important factor in forest ecology, as also the content of the humus in acid and basic buffering substances The Swedish study covers some 330 pages, with a 40-page abstract in German.

VALUES OF SCOTS AND CORSICAN PINES.—A recent number of the Oxford Forestry Memoirs (No. 6, by W. E. Hiley), entitled "The Financial Return from the Cultivation of Scots and Corsican Pine," should prove of value to those interested in afforestation work in Great Britain By means of financial calculations the author endeavours to show, using for convenience the general term *range of probability*, the financial advantages to be attained by planting either Scots pine or Corsican pine on suitable soils of different quality. Mr Hiley bases his conclusions on the possibility that higher prices may rule in the future than those at present obtainable for these timbers. It may be premised that Corsican pine costs more to raise in the initial stages than the Scots, and its timber is at present priced lower. "The result of this investigation," says the author, "shows that on first quality plantations, if the costs of the two species are the same, except that Corsican pine costs 1*l*. per acre more to plant than Scots pine, then the financial yield from the two species will be equal if the prices obtained for Corsican pine timber are 59 per cent. of those obtained for Scots pine timber of the same size. On Quality II. sites, too, the price of Corsican pine timber would have to be about 60 per cent. of that of Scots pine to yield the same financial return. If the prices for Corsican are more than 60 per cent. of those for Scots the advantage is with the former, and if they are three-quarters, the advantages in favour of Corsican pine are very great." As a result of his study of this important matter the author considers that only under the most favourable set of conditions—cheap land, planting and cost of maintenance combined with high quality growth and a rise of prices of 1½ per cent.

per annum—could Scots pine yield five per cent. compound interest on money invested in it, and under similar conditions four per cent. on second quality soil. The possibility, of doubtful practical feasibility on large areas, of so ameliorating pine soils that they would grow more profitable conifers, for example, larch, or Douglas fir, is also considered.

UNITED STATES RIVER SURVEYS.—In recent years the United States Geological Survey has published a number of monographs on various river systems from the point of view of water supply. The same department has now issued, as Water-Supply Paper 558, a preliminary index to all existing river surveys in the United States accompanied by a map showing the drainage areas. Twelve major drainage areas are recognised as the basis of the classification adopted both by the Geological Survey and the Weather Bureau. The index is by States and rivers, with references to the drainage areas indicated on the map. Maps produced by all Government departments and various States and private bodies are included. The list, which is to be revised from time to time, forms a useful guide to the cartographic resources of the United States.

TERTIARY MARLS IN NORTH CAROLINA.—Mr. L. B. Kellum undertook the task of clearing up certain doubtful relations in the Tertiary section of North Carolina represented by the Castle Hayne and Trent Marls, through a systematic study of their faunas. The result, as set forth in the *U.S. Geological Survey Professional Paper* 143, has been to show that the Castle Mayne Marl has its strongest affinity with the Jackson horizon of the Eocene, and that the Trent Marl is of approximately the same age as the Miocene 'Silex Beds' of the Tampa of Florida. The palæontological portion occupies the greater part of the paper. The Castle Hayne fauna comprises 305 species, of which 214 are Bryozoa, and these last have been described elsewhere by F. Canu and R. S. Bassler (*U.S. Nat. Mus. Bull.* 106) The Trent Marls yielded only 26 species of Mollusca. Tables of the local distribution of all these are given with systematic descriptions, especial attention being devoted to the new species and varieties. Eleven exceedingly good plates and a useful index complete this important paper.

MAGNETIC MOMENTS OF ALKALI METAL ATOMS — In the *Physical Review* for September, J. B. Taylor describes a modification of the apparatus of Gerlach and Stern with which he has carried out determinations of the magnetic moments of sodium and potassium atoms. The metals were evaporated into the apparatus at 345° C. and 245° C. respectively, and the images formed by the deposition of the atomic rays on cool glass strips were rendered visible by immersing the strips in hydrochloric acid gas, whereupon films of opaque chloride were formed. Both metals were found to possess an atomic moment of one Bohr magneton, within the limits of experimental error, which were about ten per cent.

ELECTROMETERS.—The new list of electrometers and photo-electric cells issued by the Cambridge Instrument Co., Ltd., contains complete descriptions of the instruments and outlines of the theory of their action. The table of sensitivity data of electrometers given in the list will prove of special value to research workers. Taking the instruments under normal working conditions, the sensitivities of those using microscopes magnifying 8 to 12 times with eyepiece scales of 0·1 mm. are for the tilted gold leaf 100, the string 30, and the Lindemann 40 divisions per volt; for the Dolezalek quadrant 1000 mm. and the Compton quadrant 12,000 mm. per volt on a scale a metre away. These values may be varied considerably by changing the volts on plates or needle or the diameter of the suspending fibre, with corresponding changes in the time required to obtain a reading of the instrument. The photo-electric cells are of the pattern used at the Clarendon Laboratory, Oxford.

SURVEYING INSTRUMENTS —A new catalogue (No. 541), issued by Messrs. C. F. Casella and Co., Ltd., contains a description and price list of the very large number of instruments which this well-known firm is prepared to supply. There is scarcely an instrument required by the surveyor, engineer, navigator, or draughtsman which cannot be found in the catalogue. The firm invites special attention to its new Double Reading Micrometer Theodolite. This instrument is so arranged that all four micrometers and the bubble can be read without moving from the front of the instrument. Much time is saved by this device. Another new instrument to be noted is the Casella Precise Tilting Level. The spirit-level is entirely enclosed in the instrument, and is fitted with a prism, which brings the two ends of the bubble into view in the field of the telescope. By means of a slow-motion tilting screw under the telescope, the two ends of the bubble can be brought into vertical alignment, and the telescope is then level. The adjustment of the bubble is made by moving the prism longitudinally, by means of a slow-motion screw. This enables a very fine adjustment to be obtained. Messrs. Casella are willing to let out certain survey instruments on hire.

NITROGEN IN IRON-CHROMIUM ALLOYS.—In a paper on "The Effect of Nitrogen on Chromium, and some Iron-Chromium Alloys," read at the Stockholm meeting of the Iron and Steel Institute by Mr. Frank Adcock, it is shown that when chromium is melted in an atmosphere containing nitrogen, the gas is rapidly absorbed and alloys containing up to 3·9 per cent. of nitrogen are readily obtained. Hence the melting-point of the pure metal cannot be ascertained when the melt is exposed to such an atmosphere. Pure iron, on the other hand, absorbs the gas slowly, and even when nitrogen is passed for thirty minutes over the surface of molten iron, 0·02 per cent. only is retained. Iron-chromium alloys both in the liquid and solid states take up nitrogen at high temperatures; the quantity of nitrogen in the alloy increasing with the chromium content. In alloys containing about 12 per cent. of chromium, nitrogen gives rise to a martensitic type of structure closely resembling that usually associated with iron-carbon alloys. The hardness of these alloys can be considerably modified by heat treatment, and ranges from about 115 Brinell in the annealed state to 315 Brinell when quenched. Most of the alloys containing nitrogen in the range 20 to 60 per cent. chromium present a two-phase structure under the microscope. Although one of these constituents invariably develops a structure of the sorbitic or pearlitic type on suitable heat treatment, these changes are not accompanied by any great variation in hardness. This pearlitic or lamellar type of structure is absent from the corresponding pure iron-chromium alloys, and is thus not due to carbon. It would thus appear that the presence of nitrogen in iron-chromium alloys can give rise to structures closely resembling those generally attributed to carbon in ordinary steel. Micrographs of stainless iron often reveal a martensitic type of structure which has been difficult to explain. This work on the effect of nitrogen may reveal the cause of this structure.

The Skin Constrictor (Psychogalvanic) Reflex.[1]

By Prof. R. J. S. McDowall and Dr. H. M. Wells.

The term 'psychogalvanic reflex' has been given to the fall in the electrical resistance of the skin which occurs during mental effort or emotion. It is probable that the fall in resistance in not the sole change which occurs, but from the work of Thouliss it is evident that it is by far the greatest change concerned. Various explanations have been sought for by individuals whose interests lay in special directions and who were not fully acquainted with the literature of the subject or with the physiology of the factors concerned.

It will be shown below that the fall in resistance can readily be explained as being the result of constriction of the blood vessels of the skin. In the past, this conception has been ignored because of the fact first noted by Veraguth, that the reflex was not abolished by the cutting off of the blood to the part concerned. Since, however, it has become realised, largely as the result of the investigations of Krogh, that the peripheral vessels are independent of the blood pressure, such negative evidence carries no weight.

The Influence of the Circulation on the Resistance of the Skin.

In the past too little attention has been paid to this aspect of the problem. In 1924, however, Aveling, McDowall and Wells carried out a series of experiments on chloralosed or decerebrate animals in which it was found that all procedures calculated to bring about vaso-constriction in the skin, *e.g.* hæmorrhage, adrenaline and cold, caused a fall in the electrical resistance; while conditions producing vaso-dilatation, *e.g.* obstruction of the venous return, caused a rise. They found that the fall could be brought about by sensory stimulation in a decerebrate animal, thus showing the elementary nature of the reflex, and suggested that the term 'skin constrictor' reflex should be substituted. It should be stated that conclusive evidence was obtained that the change in electrical resistance was not brought about by activity of the sweat glands. This sweat hypothesis was shown to be based on ignorance of the pharmacological action of pilocarpine and atropine. It was actually shown that pilocarpine, in the sweating stage when the blood-vessels are dilated, caused a rise in resistance, although it may be preceded by a fall in the pallor stage. In this point the results of Waller were confirmed. In final condemnation of the sweat theory, it may be stated that Golla records an example of neurotic hyperidrosis in which the sweat literally dripped from the patient who gave a normal reflex. It is inconceivable that such activity would not interfere with the reflex were it due to increased glandular activity.

The work has now been further extended by Wells, who has shown in a very simple series of experiments, the details of which will be given in a forthcoming paper, that any alteration of the circulation through the skin of the hand causes a considerable change in electrical resistance, greatly in excess of that occurring in the reflex. For example, if the carbon dioxide which normally keeps up the tone of the vasomotor centre be reduced by over-ventilation, a procedure producing an obvious pallor of the skin, the fall in resistance may amount to 20-30 per cent. of the original resistance. On the other hand, if the peripheral vessels be dilated by preventing the normal venous return by compression of the arm with a sphygmomanometer cuff at a pressure of 50 to 60 mm., there is a marked rise in resistance.

It is, however, important to note that all such experiments can only be carried out if conditions, as indicated below, are such that vaso-constriction can show itself; while it is not until the subject is thoroughly accustomed to the procedure of the experiment that the effect of psychical states can be got rid of.

The Influence of the Circulation on the Reflex.

It has long been known that in cold weather it may be very difficult to obtain the skin constrictor reflex; indeed, it is a routine procedure amongst psychologists to wash the hands in warm water in such circumstances. It is evident that if the cold causes the skin vessels to be constricted, no further constriction may be expected. Mere compression of the skin vessels by the electrodes may prevent the reflex from showing itself. There is little doubt that this accounts for the fact that it is most readily obtained from the palms of the hands and the soles of the feet, since the superficial blood-vessels in these regions are protected by a greatly thickened stratum corneum. This may readily be observed by pressing the finger on the palm and back of the hand and comparing the pressure necessary to cause an evanescent pallor. There seems little doubt that the failure to obtain a rise in resistance in blushing is due to the fact that the vessels in the face are exposed, since Wells has shown that hyperæmia of the hand, produced by plunging the hand alternately into hot and cold water, gives a marked result.

In the usual method of obtaining the reflex there is added to the pressure of the electrodes the cold due to evaporation of the saline by which they are kept moist, while the skin becomes sodden. All these factors may interfere with the appearance of the reflex.

Similarly, the reflex is abolished by drugs which cause marked dilatation and paralysis of the skin vessels, such as large doses of alcohol and atropine.

It is important also to remark that many observers who have been unable to explain the fact have noted that there is great difficulty in obtaining the reflex in patients suffering from arterial disease such as arteriosclerosis.

Evidence of Vaso-constriction during the Reflex.

It is stated by Krogh that if the ear of an unanæsthetised rabbit is observed, the occurrence of the slightest unusual sound causes the blood vessels in that region to become constricted, while Carrier, working in the same laboratory, has recorded closure of the skin capillaries of man during a thunderstorm which caused much apprehension in the subject. Hemingway in this laboratory, using Lombard's method, has found that there is commonly a closure of the capillaries of the skin during conditions which produce the reflex. The constriction is, however, limited to certain capillaries, while others remain permanently open. To be certain of these changes it is necessary to observe a given area of skin for several days in order to be thoroughly familiar with the normal state of the region; and due precautions must be taken to prevent the capillaries being affected from other causes during the observations.

[1] Summary of a paper by the author, before Section I (Physiology) of the British Association, delivered at Oxford on August 5. (From the Department of Physiology, King's College, University of London.)

It would be expected from the foregoing that if the reflex is caused by vaso-constriction, there ought to be a diminution in the volume of the limb as shown by the plethysmograph. This has been thoroughly investigated by Golla, and in a Croonian lecture he states that he not only found that there was a constriction of the limb, but also that the time relations and the degree of constriction corresponded to the change in electrical resistance. We have fully confirmed these results, which may readily be demonstrated by the 'rubber glove' method.

On searching the literature the extremely interesting fact has come to light that this was the first experiment of its kind ever done by Mosso, the inventor of the plethysmograph. Mosso records that so important did he consider the experiment that he visited Ludwig in Leipzig to demonstrate it. So impressed was the 'father of physiology' by the reduction in the volume of the limb of the subject, Prof. Paglianni, that he wrote in German on the tracing "Enter the lion."

Mosso goes on to relate how the volume of the limb changed in a subject passing from 'seen' to 'unseen' Greek translation, and remarks that in such emotional constriction we have the explanation of the common saying "Cold hands and a warm heart"

Since the blood flow through the skin influences an individual's temperature sensations, a number of common sayings such as "the blood running cold," "the pallor of fright," "eat till you grow cold," may be considered to have been placed on a definite physiological basis.

Taken together with the experiments on animals, it appears clear that the reflex is a very elementary one which may be brought about without co-operation of the higher centres, as the result of sensory stimulation. It should therefore be known as the *skin constrictor reflex* and may be considered as part of the mechanism by which the animal normally adapts itself to the anticipation of muscular exercise and defence. In man it occurs not only on sensory stimulation, *e.g.* of a pin-prick, but also in anticipation of the stimulus. Here we may look upon a threatening movement as a conditioned stimulus which has developed as an effect of experience. The fact that many of the emotional stimuli affecting civilised man may bring about a reflex so closely associated with sensory stimulation physiologically and apparently teleologically, suggests that in responding to such stimuli the individual is, in a sense, defending or preparing to defend himself. The problem appears to offer an excellent line of psychological investigation.

Fuel Research

AT the postponed annual general meeting of the Institution of Gas Engineers, commencing September 21, a number of papers were submitted, some of a professional kind, dealing with such subjects as the layout and extension of works, and the supply of high-pressure gas, while others dealt with the principles and problems of carbonisation.

Among the latter was the sixteenth Report of the Joint Research Committee of the University of Leeds and the Institution of Gas Engineers, which contained the first results forthcoming from a systematic study of the different factors which influence the results obtained in the carbonisation of coal. The first factor examined was the influence of the size of the coal particles, which was shown to exercise an appreciable influence not only on the strength and nature of the coke produced, but also on the gas yield, this latter fact being traced to a cracking of the tar, which was more pronounced with the charges made up from the smaller sizes of coal. The retort used for the process was of 'Cronite' metal supported by a complete fireclay sheath, which enabled a gas-tight apparatus to be secured working at a temperature of 1000° C. without deterioration. A carbon balance could be struck, and also a thermal balance, which confirmed the deduction previously made that the products of carbonisation contained within 2 per cent. or 3 per cent. as much potential heat of combustion as the original coal.

A paper dealing with somewhat similar subjects was submitted by Mr. T. F. E. Rhead, who described results obtained on the experimental plant of the Birmingham Corporation Gas Department. Mr. Rhead concluded by a plea for closer scientific supervision of the retorting process as essential if it is to be carried out efficiently and economically.

C. B. Marson and J. W. Cobb reported striking results which they had obtained in studying the influence of the ash constituents in the gasification of specially prepared cokes in steam and in carbon dioxide. Working on a coal containing only 1 per cent. of ash, it was found that additions of 5 per cent. of different oxides made, in some cases, great difference in the results obtained. With the same rate of steam supply, the percentages decomposed were 61 for 'pure' coke, and 82, 91, and 98 for the calcium oxide, iron oxide, and sodium carbonate cokes respectively, while the corresponding percentages of carbon dioxide in the water gas generated were 9·2, 5·4, 21·6, and 0·4 respectively. Again, the percentages of carbon monoxide found after passing carbon dioxide at the same rate through the different cokes were 6·6, 29·9, 45·6, and 89·0 for the 'pure' coke, iron oxide coke, calcium oxide coke, and sodium carbonate coke respectively, while the enhanced reactivity was also displayed by the figure for quantity in grams gasified per hour, which was more than twenty times as great for the sodium carbonate coke as for the 'pure' coke. The increased reactivity of these special cokes so tested was, in the main, due to the specific catalytic effect of the added compound, and not to the alteration in physical structure on carbonisation resulting from the addition, which was sometimes itself quite remarkable. The importance of the results in connexion with such subjects as the preparation of a free burning carbonised smokeless fuel is obvious.

The fifteenth Report of the Joint Research Committee of the University of Leeds and the Institution of Gas Engineers was of a preliminary nature, and was concerned entirely with a careful and detailed examination of the conditions which have to be satisfied if trustworthy determinations are to be made, by the iodine pentoxide method, of any carbon monoxide produced in the use of typical gas appliances.

Another report submitted at the meeting was that of the Refractory Materials Committee, in the form of a series of papers. Among these may be mentioned papers by A. J. Dale, entitled "The Testing of Refractory Material for Resistance to Slag Corrosion and Erosion," and "The Control of Silica Brick-Making, based on Load-Test Indications," one by E. J. Vickers, entitled "The Influence of Oxidising and Reducing Atmospheres on Refractory Materials," and another by A. T. Green, continuing his work on "Temperature Diffusivities and Thermal Conductivities in relation to Silica and Fireclay Refractories."

University and Educational Intelligence.

BIRMINGHAM.—The Rev. Hilderic Friend, who recently presented his collections of earthworms to the British Museum, has now given to the biological department of the University a further collection of material, on which he has been working for thirty-six years. This material includes tubes of oligochætes (chiefly enchytræids) and water worms—some of them type specimens and quite unique. The gift also includes a valuable collection of books and MSS. and material relating to the distribution of annelids in Great Britain and Ireland.

The Alcester Rural District Council has presented to the Museum of Anatomy, as a permanent loan, a number of human skulls discovered in the course of some excavations at Alcester.

Messrs. Latch and Batchelor (Wire Rope Manufacturers, of Hay Mills, Birmingham) have offered to the Department of Oil Engineering a scholarship of 60*l*. per annum for three years, to be awarded to a candidate from one of the public schools and tenable in the Department of Oil Engineering as the Latch and Batchelor Scholarship.

Prof. W. Boulton has been elected Dean of the Faculty of Science to succeed Prof. T. Turner. Dr. F. W. Norris has been appointed lecturer in the Department of Brewing.

Prof. Keesom of Leyden lectured to a large and very appreciative audience in the Physics Department, on October 18, on the liquefaction and solidification of helium.

Messrs. Cadbury Bros. have made to the city a munificent gift of more than 150 acres of land, of which 100 acres is to be devoted to the site and grounds of a hospital. The land adjoins the site of the University at Edgbaston, so that the gift will have a far-reaching effect on the medical school of the University and will do much to solve the difficulties arising from the present geographical separation of the University buildings and the General and Queen's Hospitals.

CAMBRIDGE.—Mr. R. W. Ditchburn, Trinity, has been awarded an Isaac Newton studentship. This studentship was founded for the encouragement of study and research in astronomy and physical optics.

LEEDS.—The distinction of emeritus professor has been conferred on Prof. A. G. Perkin, who has recently retired from the chair of colour chemistry.

LONDON.—Subject to the consent of the Chancellor of the Exchequer to proposals put forward by the University, the Senate has authorised definite negotiations with the Duke of Bedford for the purchase of part of the Bloomsbury site.

Dr. Percy Stocks has been appointed as from August 1 to the University readership in medical statistics tenable at University College. Dr. Stocks was educated at Manchester Grammar School (1901–1907) and King's College, Cambridge (1907–11). In 1911 he obtained a medical scholarship at the University of Manchester. Recently he has been medical officer to the Galton Laboratory (1921–26) and also lecturer in vital statistics and epidemiology at University College since 1924. His published work includes several papers on the inheritance of bodily deformity published in *Biometrika* and the *Annals of Eugenics*, and a work entitled "Blood Pressure in Early Life" (Cambridge University Press, 1924).

Dr. C. H. Lobban has been appointed as from August 1 to the University readership in civil engineering tenable at King's College. He studied at Glasgow Technical College and the University of Glasgow. After works experience he became demonstrator in engineering at Glasgow, and later lecturer in engineering at Manchester; he was professor of civil engineering at the University of Madras from 1908 until 1910. Since 1920 he has been lecturer in civil engineering at King's College, London, and has also been consulting engineer in connexion with several important buildings in London and Nottingham. He is the author of a series of seven articles on "Railway Engineering" (1920).

Dr. H. T. Flint has been appointed as from January 1 to the University readership in physics tenable at King's College. He is a graduate in mathematics and physics of the University of Birmingham. Since 1920 he has been a recognised teacher of physics at King's College, London. His published work includes papers on the theory of relativity, and on four-dimensional vector analysis in the *Phil. Mag.*, "A Generalized Vector Analysis with Applications to Electrodynamical Theory" (*Proc. Roy. Soc.*, A, 1925), and "Text-Book of Advanced Practical Physics for Students" (Methuen).

A free public lecture on "Recent Developments in Cosmical Physics" will be delivered by Dr. J. H. Jeans at University College on Tuesday, November 9, at 5 o'clock. No tickets will be required.

NOTICE is given by the Royal College of Surgeons of England that the Thomas Vicary lecture will be given at the College at 5 o'clock on Thursday, November 4, by Prof. G. Elliot Smith, who will take as his subject "The Significance of Anatomy." The Bradshaw lecture will be given on Thursday, November 11, at 5 o'clock, by Mr. E. W. Hey Groves. The subject will be "Reconstructive Surgery of the Hip Joint."

THE Northampton Polytechnic Institute, situated at the Islington end of Clerkenwell, offers in its "Announcements, Educational and Social, for the Session 1926–27" a wide variety of courses. In engineering, full-time courses extending over four years are provided on the 'sandwich' system, students in their first year attending the Institute during each of the three terms, whilst for the second and third years they attend during the first two terms only and spend the remaining five months of each year in the works of industrial firms or, when necessary, abroad. Specialisation begins with the third year, when students choose between civil, mechanical, aeronautical, electrical, and radio engineering. The Department of Applied Optics caters for (1) optical engineers, optical instrument makers, and optical glass workers, this work being co-ordinated with advanced classes conducted at the Imperial College of Science; (2) ophthalmic and dispensary opticians. A Horological Department under the direction of an advisory committee representing the British Horological Institute, the Worshipful Company of Clockmakers, and the governing body of the Institute provide a full-time one-year course designed to attract members of the trade from all parts of the country. Other subjects in which instruction is provided, mainly in the evening, are telegraphy and telephony, industrial chemistry, electro-chemistry, furriering, and domestic subjects and women's trades. Grants-in-aid are received from the Skinners' and Saddlers' Companies. Students are actively encouraged to participate in the social and recreative activities of the Institute, the plant for which includes a 100-ft. swimming-bath and 14 acres of playing-fields.

Contemporary Birthdays.

Oct. 31, 1872. Sir E. J. Russell, F.R.S.
Nov 1, 1857. Prof. John Joly, F.R.S.
Nov. 1, 1876. Capt. Henry P. Douglas, R.N.
Nov. 4, 1855. Prof. Frederick Orpen Bower, F.R.S.
Nov. 5, 1876. Prof. Harold B. Fantham.
Nov. 5, 1848. Dr. James W. L. Glaisher, F.R.S.

Sir JOHN RUSSELL was born at Frampton, Gloucestershire, and educated at Aberystwyth and the Victoria University, Manchester. Head of the chemical department, Wye Agricultural College, from 1901 until 1907, he afterwards joined the staff of the Rothamsted Experimental Station (Lawes Agricultural Trust), succeeding Sir Daniel Hall in 1912 as director. Sir John is the author of important works on general agricultural science, and on soil biology.

Prof. JOHN JOLY'S scientific career has throughout been connected with the University of Dublin. Early he was a demonstrator there of civil engineering and afterwards of experimental physics, while for the past twenty-nine years he has occupied the chair of geology and mineralogy. Since 1901 Prof. Joly has been one of the editors of the *Philosophical Magazine*. President of Section C (Geology) at the British Association's Dublin meeting in 1908, he gave an address on "Uranium and Geology." The Royal Society awarded him a Royal medal in 1910 for his researches in physics and geology. Later the Geological Society allotted him its Murchison medal in recognition of his inquiries respecting the thermal properties of minerals, the relations of radioactivity to geology, and age correlations of the earth. Prof. Joly has made important contributions to the subject of colour photography, also to the theory of biological processes, such as the ascent of sap in vegetation. He is Hon. LL.D. Michigan University.

Capt. DOUGLAS, hydrographer of the Navy since 1924, was engaged in Admiralty survey work from 1897 until 1910; afterwards he was Superintendent of Charts. He is the inventor of various appliances used in navigation.

Prof. BOWER, emeritus professor of botany in the University of Glasgow, was born at Ripon. Educated at Repton, he graduated at Trinity College, Cambridge. Following teaching work in botany at the Royal College of Science, South Kensington, lasting until 1885 (the courses were held in Huxley's laboratory), Prof. Bower removed to Glasgow. In 1909 he was awarded the Linnean Society's gold medal, and in the following year the Royal Society allotted him a Royal medal, both in recognition of distinctive and unremitting services to botanical science.

Prof. FANTHAM was educated at King Edward's School, Birmingham, the Mason College there, University College, London, and Christ's College, Cambridge. Sometime lecturer in parasitology at the School of Tropical Medicine, Liverpool, he became demonstrator in biology at St. Mary's Hospital Medical School, London, and afterwards went as assistant to Prof. Nuttall at Cambridge. In 1917 he was appointed to the chair of zoology in the University of the Witwatersrand, South Africa.

Dr. GLAISHER was born at Lewisham. Educated at St. Paul's School, he passed into Trinity College, Cambridge (of which he is a fellow), graduating second wrangler. Author of many original papers in pure mathematics, and editor of two mathematical journals, the Royal Society awarded him its Sylvester medal in 1913. Dr. Glaisher has been twice president of the Royal Astronomical Society.

Official Publications Received.

BRITISH AND COLONIAL.

Western Australia. Annual Progress Report of the Geological Survey for the Year 1925. Pp. 37+7 plates. (Perth: Fred. Wm. Simpson.)

Publications of the Dominion Astrophysical Observatory, Victoria. Vol. 3, No. 9: The Velocity Curves of 12 Lacertae and the Radial Velocities of 48 Stars. By William H. Christie. Pp. 209-223. Vol. 3, No. 10: Four Double-Lined F-Type Spectroscopic Binaries. By W. E. Harper. Pp. 225-245+1 plate. Vol. 3, No. 11: Three Spectroscopic Binary Orbits. By J. S. Plaskett. Pp. 247-264. Vol. 3, No. 12: The Orbits of Two Double-Lined Spectroscopic Binaries. By W. E. Harper. Pp. 265-273. (Victoria, B.C.)

Report of the Council of the Natural History Society of Northumberland, Durham and Newcastle-upon-Tyne, intended to be presented at the Annual Meeting of the Society, 21st October 1926. Pp. 42. (Newcastle-upon-Tyne.)

India: Live-Stock Statistics, 1924-25. Report on the Second Census of Live-Stock, Ploughs and Carts in India, held between December 1924 and April 1925. Pp. 8. (Calcutta: Government of India Press.) 2 annas; 3d.

Report and Balance Sheet of the National Botanic Gardens of South Africa, Kirstenbosch, Newlands, Cape (and the Karoo Garden, Whitehill, near Matjesfontein), for the Year ending 31st December 1925. Pp. 24. (Kirstenbosch, C.P.)

Animal Breeding Research Department, the University, Edinburgh. Report of the Director for the Year April 1st 1925 to March 31st 1926 (being the 6th Annual Report). Pp. 28. (Edinburgh.)

The National Institute for Research in Dairying: Its Work and Needs. By the Staff of the Institute. Pp. 52. (Shinfield, Reading.)

The Scientific Proceedings of the Royal Dublin Society. Vol. 18 (N.S.), No. 25: Photo-electric Measurements of Illumination in relation to Plant Distribution, Part 1. By Dr. W. R. G. Atkins and Dr. H. H. Poole. Pp. 277-298. (Dublin: Royal Dublin Society; London: Williams and Norgate, Ltd.) 2s.

FOREIGN.

Sitzungsberichte der Physikalisch-medizinischen Sozietät zu Erlangen. Herausgegeben im Auftrag der Sozietät von Oskar Schulz. 56 und 57 Band, 1924, 1925. Pp. xx+494. (Erlangen.)

Journal of the College of Agriculture, Hokkaido Imperial University, Sapporo, Japan. Vol. 17, Part 2: Contributions to the Knowledge of Abscission and Exfoliation of Floral Organs. By Prof. Isawo Namikawa. Pp. 63-131. Vol. 18, Part 2: Erster Beitrag zur Ichneumoniden Japans. Von Toichi Uchida. Pp. 43-173+Tafeln 6-10. (Sapporo.)

Department of Commerce: U.S. Coast and Geodetic Survey. Serial No. 350: Report on the Readjustment of the First-Order Triangulation Net of the Western Part of the United States. By Oscar S. Adams. Pp. 9. (Washington, D.C.: Government Printing Office.) 5 cents.

The Institution of Electrical Engineers. List of Corporate Members, and of Non-Corporate Members (Graduates, Students and Associates) of the Institution, including a List of Names arranged Geographically. (Corrected to 1st September 1925.) Pp. 367. (London.)

List of Members of the Institution of Civil Engineers. Addresses corrected to 1 July 1926. Pp. 315. (London.)

The Institution of Mechanical Engineers. List of Members, 1st May 1926. Pp 433. (London.)

Publication No. 586: Recent Improvements in the Design and Construction of Surveying Instruments. Pp. 11. (London: Cooke, Troughton and Simms Ltd.)

Wild-Barfield High-Temperature Electric Furnaces for the Heat Treatment of High Speed Steel and General Purposes requiring Temperatures up to 1400° C (Section K.) Pp. 8. (London: Automatic and Electric Furnaces, Ltd.)

Photo-micrographic Apparatus and Accessories. (Reference: Mikro 401.) Pp. 107. (London: Carl Zeiss (London) Ltd.)

Publication No. 1: Astronomical and Optical Instruments. A History of the Foundation of the Company and of its Achievements in the British Optical Industry. Pp. 48. (Newcastle-on-Tyne: Sir Howard Grubb, Parsons and Co.)

Diary of Societies.

SATURDAY, OCTOBER 30.

INSTITUTE OF METALS (North-East Coast Local Section, jointly with Institute of British Foundrymen) (at Neville Hall, Newcastle-upon-Tyne), at 6.15.

ROYAL SOCIETY OF MEDICINE (Study of Disease in Children Section) (at Children's Hospital, Birmingham).

MONDAY, NOVEMBER 1.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.—General Meeting.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—C. E. Shattock: Demonstration of Scrotal Tumours.

SOCIETY OF ENGINEERS (at Geological Society), at 5.30.—Miss A. Ashberry: Some Products of a Small Machine Shop.

CHILD-STUDY SOCIETY (at Central Hall, Westminster), at 6.—Sir M. E. Sadler: Sandford and Merton.

INSTITUTION OF AUTOMOBILE ENGINEERS (Bristol Centre) (at Merchant Venturers' Technical College, Bristol), at 6.45.—G. F. Mucklow: The Effect of Reduced Intake-Air Pressure and of Hydrogen on the Performance of the Slow-speed Solid Injection Engine.

ARISTOTELIAN SOCIETY (at University of London Club), at 8.—Prof. C. Lloyd Morgan: Objects under Reference (Presidential Address).

SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Chemical Society), at 8.—Dr. H. Drake-Law: Artificial Colours used in Foodstuffs.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.30.—Presidential Address.

labours of the veterinary departments being devoted to the prevention and cure of disease. There are large areas in Sierra Leone free from tsetse fly, but no attempt has been made to introduce cattle. The researches of the French and the Belgians in the adjacent territories into the breeding of types of cattle immune from trypanosomiasis seem to be unknown to us, although Mr. Ormsby-Gore mentions the fact that there are a few thousand head of a small type of non-humped forest cattle in Southern Nigeria, uniformly healthy, apparently unaffected by the tsetse fly with which they are frequently in contact.

It was the existence of this immune type in Fonta-Djalon, Upper Guinea, Upper Gambia, and the Lower Saloum which led the French to investigate the relation between species, the size of species, and immunity, and to the interesting discovery that susceptibility to trypanosomiasis in all types of domestic or semi-domestic stock increases with their size. Further, it was established that the native herdmen had made use of this fact to produce, by crossing the immune species with the larger zebu (humped) varieties of cattle, the Djakore or Bambara species of cattle which retain much of the original resistance. On these bases crossing experiments were carried out in the Belgian Congo, with marvellous results, according to M. Roubaud, the chief of the laboratory of the Pasteur Institute.

Another aspect of animal husbandry is also emphasised: "Research in the mineral, as well as the vegetable, nutrition of stock appears to be well worth undertaking. The whole question of crossing, selection of bulls, and the improvement of herds is ripe for examination." In regard to plant products, it is recommended that each of the four territories should maintain a central research station, to which should be attached experimental farms, and connected with the principal agricultural training college for natives. The research carried out at these stations "should be co-ordinated not merely in West Africa, but with the similar research which is being carried on in Trinidad and at Amani in East Africa." Scientific workers will welcome the statement: "If we are to develop our tropical possessions we must realise the value of the scientific staff, both in the laboratory and in the field, and we must provide careers in the agricultural departments in the Colonies which will attract personnel possessed not only of high technical qualifications, but of capacity for leadership and ability to inspire others."

Mr. Ormsby-Gore, while recommending a research policy, makes no recommendation as to the priority of research. A fairly comprehensive programme of investigation is laid down, particularly in regard to human, animal, and plant diseases, and the breeding of improved varieties of domestic stock and plants, but what is lacking is a definite recommendation for the allocation of a specific sum to research. What is wanted in tropical Africa is a fund similar to that at the disposal of the Department of Scientific and Industrial Research in Great Britain, which would not depend upon the vagaries of the local directors of agriculture or the local governors. Such a fund might be created by the apportionment of a percentage of an export tax on palm-oil, cotton, cocoa, or any other of the principal products.

The need for further research in tropical diseases and the measures to be taken to secure a healthy and increasing population are emphasised, but not over-emphasised. In the absence of vital statistics, it is impossible to determine whether the population of West Africa is increasing, or stationary, or declining. Mr. Ormsby-Gore states that the general impression appears to be that the native population is increasing, but very slowly and imperceptibly. Where there are statistics available regarding the native population, as in certain parts of South Africa, it is proved that the rate of increase of native population is steadily diminishing. Contact with the white races apparently has this inevitable effect. Generally speaking, it can be said that in spite of the energetic methods adopted to stamp out disease, in spite of the knowledge we have acquired of the diseases which afflict the African populations and the means by which they can be prevented, the native population over the whole of tropical Africa is either stationary or declining in numbers. Bodily disease is not the only determining factor in this result. A psychological factor has to be taken into account. Rivers and others have attributed the decline of primitive populations to the loss of interest in life following upon the breakdown of their institutions, the suppression of their customs, and the atrophy of native arts and crafts on impact with our different institutions and different culture. We are confronted, therefore, with the dual task of disseminating knowledge of the means of preventing disease and getting the natives to apply it, and of arousing interests in new activities to replace those which have been lost.

The identifiable diseases which take the greatest toll of human life and energy in West Africa are malaria, dysentery, yaws, yellow and blackwater fevers, sleeping sickness, and leprosy among tropical diseases, and plague, venereal diseases, smallpox, and tuberculosis among the general afflictions of mankind. Many of these diseases could be dealt with at village dispensaries, if trained dispensers were available. Mr. Ormsby-Gore rightly stresses the need for the provision of centres where natives can be trained in the diagnosis and treatment of the commoner complaints, and for native sanitary orderlies whose duties would include the

destruction of the breeding-places of mosquitoes, both anophelines and Stegomyiæ, the destruction of rats, supervision of the general sanitation of towns and villages, the prevention of water pollution, and the notification of disease. These subordinate medical and sanitary staffs should not be drawn exclusively from the better educated coast natives, but, so far as possible, from every tribe in the interior. " A native is prepared to trust a European medical officer; he is also prepared to pay attention to a man of his own race, but he is not prepared to extend the same confidence to the African from another tribe." Even if he were, it is obviously desirable that knowledge of disease and its prevention should be possessed by some members of every tribe. We must help to supplant the 'medicine man' by the medical man drawn from the same tribe.

Emphasis is also laid on the need for training women for maternity and child-welfare centres. The infant mortality rate is grievously high in western as in all parts of tropical Africa, and the high proportion of still-births to births is one of the most deplorable features of tribal life. For the high mortality rate malnutrition is to be held responsible, but the number of still-births and abortions must be attributed to the prevalence of venereal disease and malaria. It seems fairly well established from the recent researches of Mr. Buxton in Melanesia that malaria is one of the principal determining causes of abortion and still-births. There is no reference, however, to these recent researches in the report before us. The difficulties in finding women sufficiently well educated to undertake the work of maternity and infant welfare are due to the neglect of female education. " The comparatively small provision which has been made for the education of girls as compared with the provision made for boys is very noticeable throughout West Africa." Mr. Ormsby-Gore's plea for going slow in this matter is not one which will commend itself to any well-wisher of West Africa. There is an urgent need for immediate and even precipitate action directed towards raising up a well-educated class of women. Reading the report, one feels that Mr. Ormsby-Gore overestimates the value of hospitals where surgical operations can be carried out, and underestimates the possibilities of schools for the native infants and adults where much could be done to build up the necessary outlook on disease. The creation of a large number of hospitals, which he advocates, while there are very few schools, is as wise as the present habit in Great Britain of spending large sums of money on the maintenance of sanatoria for consumptives but doing practically nothing to destroy the slums which provide the greater number of patients for the sanatoria.

A tremendous importance is attached by Mr. Ormsby-Gore to the need for greater transport development. He instances the remarkable progress made in the export of ground-nuts following the construction of the railway to Kano. Between 1910 and 1925 the exports of this crop from the Kano-Zaria district rose from 1910 tons to no less than 127,000 tons. He shares with Sir Frederick Lugard the belief in the productive capacity of the peoples to make any railway pay, and in the civilising influence of the railway. A considerable part of the report is devoted to detailed consideration of a railway, road, and harbour programme, but only passing reference is made to the need for systematic research into the possibilities of the flexible track vehicle. This type of vehicle, which is already in an advanced stage of development, and has been used by the Empire Cotton Growing Corporation for the transport of cotton from remote areas, possesses the inestimable advantage that it can traverse roadless country. It is a road-maker rather than a road-breaker. If improved, it would enable every part of the tropics, however remote, to be brought within the reach of regular transport services, and thus not only free for productive work thousands of labourers at present engaged in the wasteful system of head-porterage, but would also save the country the expense of making metalled roads, which are expensive to make and more expensive than a railway to maintain.

The report as a whole will repay the closest study by scientific workers. They have every reason to be grateful to Mr. Ormsby-Gore for re-emphasising the urgent necessity for applying the methods and results of science to the problems of tropical development, both in administration and production. A vast field of research is indicated, a field which it may be hoped will be surveyed with the least possible delay. Scientific workers must realise that they have a special responsibility in the matter. The knowledge which can be gained from scientific research is probably the most important factor in the full realisation of the potentialities of the vast British tropical possessions, and it is essential therefore that funds should be forthcoming immediately for the initiation of a bold programme of research. There is not the least excuse for Great Britain to lag behind other Colonial powers in this respect; there is every reason for it to lead the way. It is not enough for Mr. Ormsby-Gore to produce a report which will establish his reputation as the most far-sighted younger statesman of the day. His observations, his vision, and his recommendations must be appreciated by the nation, and this will be possible only if the scientific community assist the nation to a fuller understanding of the value of scientific research in every sphere of national and imperial endeavour.

Echoes of Tennessee.

Evolution and Religion in Education: Polemics of the Fundamentalist Controversy of 1922 to 1926. By Prof. Henry Fairfield Osborn. Pp. xiv + 240. (New York and London: Charles Scribner's Sons, 1926.) 7s. 6d. net.

ECHOES of the Fundamentalist controversy continue to travel across the Atlantic. The present volume consists of a collection of articles and addresses by Prof. H. F. Osborn dealing with the situation created by this strange revival. It is a phenomenon very difficult to cope with, being a product of popular education and democratic government. The only cure is more education of the right sort, but the Fundamentalists are striving to capture the educational machine. Prof. Osborn is aware that a mental atmosphere prevails not very favourable to scientific truth. "I hold," he says, "that the press and the movies are by far the most potent influences upon conduct in America at the present time." He regards the sum of press influence as morally good but intellectually bad, "because it creates what I call the jazz mind and a disproportionate sense of relative values."

The trouble with people at a certain stage is not only that they cannot appreciate evidence, but rather that they have positively no sense of spiritual or religious values. To attach religious value to the historicity of the myths in Genesis is a mark not only of intellectual, but also of religious, myopia. At this stage, one is either a Fundamentalist or a Secularist; it does not greatly matter which, for the two are correlatives. The tragedy of the situation, as Prof. Osborn points out, is that this recrudescence of superstition has broken out just at a time when the conceptions of men of science have become anti-materialistic. He himself says (p. 91): "If I have made a single contribution to biology which I feel confident is permanent, it is the profession that living Nature is purposive."

One remark of Prof. Osborn's seems to us especially noteworthy: "In my opinion religion and science will unite to control the future of mankind. This will be a simplified religion and a reverent science" (p. 177). But what is a "simplified" religion? Apparently Prof. Osborn hopes to get people to agree upon "a simple, elemental, and more or less primeval teaching on which all men, except those who persuade themselves that they are atheists, agree." It would include the Ten Commandments, the Lord's Prayer, the Sermon on the Mount, and "passages from the teachings of St. Paul and other missionaries." But this is the eighteenth-century chimera of natural religion in a new dress. Prof. Osborn overlooks the fact that these enshrinements of religious and moral teachings are based on a definite philosophical outlook, not always formulated, but capable of quite definite formulation.

This 'hang theology' attitude will not work—at least not for long. If the specific Christian view of God goes, the Christian value-scheme will follow, and carry along with it Christian ethics. This strikes us as a surrender. The strength of the Fundamentalist lies in his quite definite scheme of belief; and unless the Modernist or man of science can offer something equally definite and equally religious, he will neither win nor deserve to win. The future will be divided between the Fundamentalists and the Secularists, who alike know what they believe and why they believe it. There is no room for a vague religiosity, at least in a democratic country like America.

We have left ourselves very little space for estimating the more definitely scientific aspects of the book. Indeed, its excellence here should be beyond criticism. Prof. Osborn speaks throughout with the directness, lucidity, and easy freedom of the specialist and experienced teacher. Especially interesting is his exposure of the Fundamentalist misrepresentation of evolutionary teaching as deriving man's descent from apes. "The entire monkey-ape theory of human descent is a pure fiction," he says. The human line of descent is entirely independent of the apes; it is to a common ancestor that the two may be traced. This, perhaps, is all one to the Fundamentalist, in whose arguments caricature and invective take the place of facts and logic. We may hope that the perusal of this book may abate some Fundamentalist prejudices, at least in the case of those whose minds are still capable of reflection. We think that Prof. Osborn has done a public service to his countrymen in preparing and publishing it; it cannot always have been congenial work for a disinterested student of science who stands above the clamours of controversy.

J. C. H.

Prehistory in Britain.

Proceedings of the Spelæological Society for 1925. No. 3, Vol. 2. (University of Bristol.) 3s.

WHEN the editor of NATURE asked me to review the above work, I was particularly pleased to do so. It has always been a source of satisfaction to me personally that I was partly instrumental in turning the attention of the Spelæological Society of the University of Bristol, shortly after the War, towards prehistoric investigations. Previously, though the Society and its predecessor bore an honourable record for researches on underground water-ways, etc., little serious prehistoric work had been attempted. The

work of the 'Spelæos' has barely received the recognition it deserves; most people would be astonished to see how much material has been already collected and classified in the last few years; a visit to the Society's museum—housed in the new buildings of the University of Bristol—has become a necessity for all prehistorians. The difficulty has been that a few years ago—rightly or wrongly—the Society decided to publish its own *Proceedings* instead of combining with one of the older societies for this purpose. Folk as a rule are rather suspicious of new provincial publications of this kind, and it is to combat these suspicions in this particular case that this review is written.

The Society started its prehistoric explorations by having two pieces of rare good luck. I often wonder if my friends the 'Spelæos' realise how fortunate they were! Avelines Hole has proved a most important find of late Palæolithic date, and has yielded a rich and interesting collection of flint implements, not to speak of a harpoon—one of the very few found in Britain and several portions of human skulls. The second 'plum' was the Keltic Age cavern, and this was certainly no small discovery. Although starting off straight away with these first-class sites, members rose to the occasion and very creditable excavations were undertaken and duly published. Lately attention has been turned northwards and investigations started in the Wye valley; of course, Mendip—the first love—is by no means being neglected.

The present *Proceedings* contain a most attractive series of papers; mostly they are concerned with the various activities of the Society, but one or two articles on more general matters by outside contributors are included. The contents comprise: A fifth report on Rowberrow cavern, a third report on excavation of Mendip Barrows, a second report on excavations in the Wye valley, and a note on a Roman site on Bedminster Down; a short account of Guy's Rift, Slaughterford, follows, with a detailed description by Mr. L. H. D. Buxton of the early Iron Age skull found there. Other articles include: A study of certain caves in the north in relation to the ice ages by Messrs. L. S. Palmer and L. S. Lee, a survey of Upper Palæolithic industries from some Mendip caves by Mr. J. A. Davies, a note on the Upper Palæolithic in Britain by Miss D. A. E. Garrod, and a study of flint-flaking by Mr. H. Warren.

Among so much that is interesting it is rather invidious to pick out any special paper, but it is clearly impossible here to discuss such a long table of contents. Perhaps readers will be especially interested in the reports on Rowberrow cavern and the investigations in the Wye valley. The 'Spelæos' started work at Rowberrow several years ago—their first publication on the subject was in the *Proceedings* for 1920–21. Thanks to outside financial assistance, it has been possible to proceed on a large scale and the present (fifth) report gives a very complete picture of the various cultures found there. Quite a number of flint implements occurred, but it has been found that, though a late Neolithic industry is present, they mostly date to more recent periods—some being even Roman in age. Of course, it has been realised for some time past that the introduction of metal into the British Isles did not lead to the complete eclipse of all flint work, and that many of the surface finds are comparatively recent in date, but it is always satisfactory to have fresh confirmation, especially when a definite stratigraphy occurs. The discovery at Rowberrow of pigmy tools—though without, of course, the Tardenoisean burin—in late Neolithic layers is also interesting and confirms the assertions of H. Warren, who claims that some geometric pigmies in Essex are certainly not earlier in time than the late Neolithic and may even date to an early metal age.

Somehow or other the Wye valley seems to have been rather neglected by prehistorians. So long ago as 1919, in a note in the first *Proceedings* of the Society, I urged that attention should be turned to this favoured valley. The results of two seasons' work merely whet the appetite for more. King Arthur's cave—originally excavated in the 'seventies—has naturally first attracted the diggers, and it is surprising what they have obtained from what appeared at first sight a completely emptied chamber. But the whole district is simply riddled with caves and rock-shelters, and it will be astonishing if further investigation in future years does not bring to light other and still more interesting 'King Arthur's caves.'

The current *Proceedings* forms a notable publication, and the Society is to be indeed congratulated: archæologists can no longer afford to neglect its activities.

M. C. BURKITT.

Surfaces, Molecules and Ions.

An Introduction to Surface Chemistry. By Eric Keightley Rideal. Pp. viii+336. (Cambridge: At the University Press, 1926.) 18*s*. net.

THAT the cohesive forces which hold solid and liquid masses together, and produce the phenomena of capillarity at their surfaces, are ultimately identical with the forces producing chemical change, is an idea which has been latent in studies on capillarity since their inception. But the growth of this idea into a living theory, with power to inspire and guide many researches into the structure of surfaces, the surface properties of molecules, and the

mechanism of evaporation, solution, and catalysis, has been delayed until the last fifteen years. Dr. Rideal's book is probably the first in any language to attempt a presentation of all the modern developments of this idea. After an introductory chapter on pure liquids and their surface energy, the author presents Gibbs' adsorption equation—the reappearance of much of the original proof is to be welcomed—and plunges into the most recent work on surface films on liquids. A chapter on liquid-liquid interfaces includes information on emulsions and suggestions for bridging the gap in our knowledge between the theory of capillarity and of solution; solid-gas interfaces are treated with reference to crystal structure and to recent work on catalysis; adsorption, surface reactions, crystallisation, and disintegration are included under solid-liquid interfaces, and the section on electrification deals with the adsorption of ions, the double layer, cataphoresis, the Donnan equilibrium, and other subjects. There are two concluding chapters on the most important points in the theory of colloids, including the theory of Brownian movement, the charge on colloidal particles, and the structure of gels. The effects of adsorption in its manifold forms are traced through a great variety of phenomena.

The book is an able survey of an extensive literature full of interest at the present time. It is written with a keen enthusiasm and abounds in well-chosen references and in original suggestions. Its conception and plan are excellent. But close reading reveals that it is not particularly trustworthy as a text-book, and that it suffers from lack of thorough and critical digestion of the material and from hasty revision. For example, in the table of cross-sections of organic groupings on p. 77, values appear for –NC and CONHϕ, neither of which has been measured, and there are several other mistakes besides. On p. 129 the formula for the rate of growth of tarnish films on metals, as limited by the slow diffusion through the film already formed, is given without proof, and wrongly. It is not quite fair to the uninitiated reader to expect him to recognise the physical factors at work in this phenomenon from a misprinted formula, and no further explanation than that it is "the ordinary diffusion law." Elsewhere a thermodynamical argument is based on the hysteresis of the contact angle as if it were a reversible phenomenon, although it has been shown to be frictional in nature and irreversible; Harkins' 'oriented wedge' theory of the inversion of emulsions is given without noticing that its author has brought forward evidence very damaging to its simple form; and the theory of the very important 'maximum bubble pressure' method for determining surface tension is dismissed with an approximate formula and the remark that it "corresponds closely with that of the drop-weight method," which is scarcely a correct indication of the actual state of these theories. Sugden's development of the first of these methods ought to have been at least mentioned, as it gives not only the most accurate theory at the present time, but also an apparatus which, on the grounds of convenience and accuracy combined, is probably the best now available for ordinary use. Sometimes the author seems merely to have handed his notes to the printer, as when on p. 295 a hypothesis is given and the fact of its having been tested, a few words necessary for grammar are omitted, and the result of the test is not stated; and the nickname "McLewis" surely should not be used in print.

Some blemishes are, however, inevitable in a pioneer work on a rapidly growing subject, and the reader who will consult the original literature to which this book introduces him, when he needs fulness and accuracy, will find the book invaluable. It is alarming that, only a few months after the appearance of the book, it is already seriously out-of-date on some points fundamental to the theory of surface films. The book is likely to be found readable by fully trained students of physical chemistry; other scientific readers may find that the demands made on a previous knowledge of current technical terms and mathematical symbols are too heavy. Those who, like the reviewer, are already engaged in investigations on the subject will find it indispensable; and we may look confidently for fresh students to be attracted as a result of reading it.

N. K. ADAM.

Transmission of Stimuli in Plants.

The Nervous Mechanism of Plants. By Sir Jagadis Chunder Bose. Pp. xix+224. (London: Longmans, Green and Co., Ltd., 1926.) 16s. net.

ALL the recent work on cell respiration and nutrition leads to the conclusion that a real similarity exists between these processes in the plant and animal organisms. This being the case, it would seem possible that the mechanism of the transmission of stimuli may also be fundamentally the same in both. The problem of transmission in the plant has not received so much attention as that in the animal, on account of the comparative difficulty of dissecting plant tissues for experiment, but nevertheless a considerable number of theories have been put forward to explain the few known facts. Broadly speaking, the theories hitherto produced fall into two classes: those which attempt an explanation on a mechanical basis and those which incline to the idea of chemical stimulation. Sir

Jagadis Bose introduces a new conception—that of 'physiological excitation.'

None of the older theories has been sufficient to explain all the facts and the extreme rapidity with which a stimulus is effective in *Mimosa pudica* and other sensitive plants: these, when not completely ignored, have always been a stumbling-block. It is therefore of interest that in the present work, Mimosa has been chosen for the subject of the fundamental experiments.

Briefly, Sir Jagadis Bose claims to have found that in Mimosa there exists a definite nervous system which he believes is in practically every way identical with that of the animal. He repeats on this plant most of the classical experiments on animal nerves and nerve-muscle preparations. By means of the most ingenious apparatus he identifies the phloem with the actual conducting tissue; he demonstrates the falling of the leaflets under various stimuli, the time between the application of the stimulus and the response varying with the distance of the leaflet from the point of excitation. He finds that the falling leaflets are confined to the stimulated side except when the stimulus (usually electrical) is intense, when the response travels up one side and down the other; this is taken as evidence for two unilateral conducting strands meeting at the apex of the leaf. The latent period and the rate of transmission of the stimulus have also been measured, and it is found that the phenomena of make-and-break electrical stimulation are the same as in animal tissues.

Mimosa was chosen for these experiments on account of its rapid and definite reactions, but this class of plant stands alone in the vegetable kingdom, and it is doubtful whether theories based entirely on such experiments as these could be applied to all plants. An electrical reaction corresponding to the action current of an animal nerve is said to have been demonstrated for several plants.

In view of the need of confirmatory evidence and of the hostile criticism which this work is likely to evoke from orthodox botanists, it is greatly to be regretted that the experimental conditions are not given in greater detail. We have no doubt that every reasonable precaution was used, but it is hard to reconcile the observation that temperature has a very definite effect on the rate of transmission with entire absence of any attempt to control it in other experiments. Apart from any effect on the plants, the conditions must surely have been very carefully controlled when dealing with such very sensitive apparatus; the reflecting galvanometer used in some of the experiments gave a deflexion of 1 mm. at a distance of 1 metre for a current of 10^{-10} amperes.

Sir Jagadis Bose is to be congratulated on the way in which he has treated the problems and on designing so many instruments for exact measurement. It is difficult to believe, however, that he will succeed in demonstrating in plants a central nervous system, the presence of which he seems to suspect.

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The Useful Trees of Northern Nigeria. By H. V. Lely. Pp. xii + 128 + 120 plates. (London: The Crown Agents for the Colonies, 1925.) 10*s.* net.

MR. LELY has rendered a service to African forestry by the preparation and publication of his descriptive account of 128 of the useful trees of Northern Nigeria. This book will be helpful not only to his colleagues but also to forest officers in other African colonies, to which many of the trees described extend their range. The author's method may be commended to the consideration of others who, we hope, will follow his example; as he expresses it, his aim has been to describe and illustrate the material as it appears to be and not only as it actually is from the scientific point of view, avoiding botanical terms except where they have no alternative. Technical descriptions can always be provided by the compiler of a flora, working at home, but information such as that supplied by the author of the work under review can only be given by 'the man in the field.'

If other colonial forest officers will follow Mr. Lely's lead, by giving us illustrated accounts of the dominant trees of their areas, it will be of great assistance to their colleagues and successors, and will help to prevent many erroneous determinations such as are now so commonly met with. Such accounts would tend also to bring to light the still too numerous species not yet identified botanically, and would furnish us with much-needed information as to the 'habit' of the various species discussed.

A few slight corrections ought, perhaps, to be noted for the benefit of African forest officers. The genus Lophira has been retained by Mr. Lely in the Dipterocarpaceæ instead of in the Ochnaceæ, to which family it is now referred. The genera Eriodendron, Ceiba, and Bombax are now usually separated from the Malvaceæ to form a distinct family, the Bombacaceæ; *Eugenia guineensis* is now generally placed in a separate genus, Syzygium, as *S. guineense.* Sir David Prain's revision of the African species of 'Afzelia' under the generic name Pahudia appears to have been overlooked, for *Pahudia africana* (Sm.) Prain appears as *Afzelia africana.*

We sincerely hope that Mr. Lely will feel encouraged to continue the good work until all the trees of his region have been described and figured.

J. BURTT DAVY.

Synonymy of the British Non-Marine Mollusca (Recent and Post-Tertiary). Compiled and Annotated by A. S. Kennard and B. B. Woodward. Pp. xxiv + 447. (London: British Museum (Natural History), 1926.) 20*s.*

THIS work is almost devoid of readable matter, but is nevertheless of fundamental importance to all who are engaged in research on non-marine Mollusca or on the Pleistocene deposits. It gives a list of all the genera, sub-genera, and species (recent and post-Tertiary), with bibliographical references, together with the etymology of the names adopted, and the geological range of the species in Great Britain. The names used are those which, in the opinion of the authors, most nearly accord with the requirements of the International Rules of Zoological Nomenclature. 172 species of gasteropods and 37 of lamellibranchs are recorded, most of which are found fossil in the Pleistocene, and some in the Pliocene deposits. About 16 per cent. of the species are extinct in Great Britain. Some idea of the immense labour involved in the preparation of this work can be formed from the bibliography, which occupies 54 pages.

Memoirs of the Geological Survey, Scotland. The Economic Geology of the Central Coalfield of Scotland. Area 5: Glasgow East, Coatbridge and Airdrie; with Chryston, Glenboig, Greengairs, Slamannan, Caldercruix and Salsburgh. By Dr. C. T. Clough, L. W. Hinxman, W. B. Wright, E. M. Anderson, and R. G. Carruthers; with contributions from Dr. R. Kidston, Dr. G. W. Lee. Second edition, with additions by M. Macgregor. Pp. x + 171 + 13 plates. (Edinburgh and London: H.M. Stationery Office; Southampton: Ordnance Survey Office, 1926.) 5*s.* net.

THIS memoir is a new edition (with corrections and additions) of that on the same area, first published in 1916. In addition to minor corrections and amplifications, Chapter ii. dealing with the Carboniferous Limestone series, in which certain important coal seams occur, has been almost entirely rewritten, whilst there have also been some changes in Chapter iii. dealing with the Millstone Grit. It is evidently of great importance that, as fresh information is available, works such as these should be kept up-to-date and amplified where necessary.

Erde und Weltall. Von Svante Arrhenius. Aus dem Schwedischen übersetzt von Dr. Finkelstein. Pp. vii + 342 + 2 Tafeln. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1926.) 12 gold marks.

THIS is a German translation from the Swedish; it is a combined and revised version of the two earlier works by the author, published in 1906 and 1915. The book deals only with the solar system, with special reference to the earth and geophysics (including atmospheric physics and climatology). It is written in picturesque and discursive style, and there are numerous small illustrations. Many references are made to very recent work.

Solutions of the Examples in a Treatise on Dynamics of a Particle and of Rigid Bodies. By S. L. Loney. Pp. vi + 240. (Cambridge: At the University Press, 1926.) 17*s.* 6*d.* net.

PROF. LONEY has here provided complete and concise solutions to the examples of his well-known treatise on dynamics, which will be very useful to teachers and to those advanced students of applied mathematics who are sufficiently mature to know the legitimate use of such a key.

Physische Erdkunde: die Gestaltung der Erdoberfläche. Von Prof. Dr. Richard Lehmann. Pp. vii + 240. (Braunschweig: Friedr. Vieweg und Sohn A.-G., 1925.) 12·50 gold marks.

THIS is a text-book of physical geography, of the usual type. The processes of development of surface features are described at length, and the illustrations are numerous. The earth's thermal state is mentioned, but radioactivity is not.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Welsh Romani.

I HAVE just read Prof. Turner's review of my "Dialect of the Gypsies of Wales" in NATURE of August 28, and trust you will permit me to make a few comments.

Prof. Turner refers to the "well-established rules of Gypsy," *i.e.* the phonetic correspondences between Sanskrit and Romani, but omits to mention that my book is the first to supply a full and systematic series of these phonetic equations: for the earlier lists of Ascoli and Miklosich are too incomplete to be of service. These equations have been deduced in the first place from examples where the correspondence between a Sanskrit and Romani word is indisputable, and afterwards applied to the elucidation of words the etymology of which is in doubt. Hence my etymologies, which he appears to assign to guess-work, have all been based upon a belief in that "constancy of sound-laws" which he charges me with ignoring. By no other method would it have been possible to arrive at such new derivations as *bār*, 'stone,' from Skr. vaṭa; *bivan*, 'unripe,' from Skr. vimlāna; *lil*, 'book,' from Skr. likhita, *phabai*, 'apple,' by reduplication from Skr. phala, and many others. I am therefore in agreement with Prof. Turner as to the principle that "a given sound in a given dialect will develop in the same way in all words in which it appears under the same conditions," and only question his application of this rule.

In the single example cited by Prof. Turner, namely, Rom. *šukār*< Skr. sukṛta, he emphasises his point by the statement that I give this derivation "without hesitation," although in the vocabulary I first quote Miklosich's śukra, following it by a doubtful "rather perhaps to be connected with Skr. sukṛta"; while in my chapter on the History of Romani Sounds (§ 130) I cite it with a prefixed query mark. My reason for connecting Gypsy *šukār* with Skr. sukrta is the analogy of three other Romani words from the same Skr. √ kṛ, compounded with prefixes ending in a vowel, where the -k-, though intervocalic, remains. These are:

raker- (Gk. Gyp. *vraker-*, Arm. Gyp. *pakr-*), 'to talk,' derived by Finck from Skr. prakṛ, Prākr. pakar- -an etymology which the Sanskritist Ernst Kuhn in 1909 hails as 'sehr glucklich,' explaining as it does the forms in Eastern and Western dialects,

pariker-, 'to thank'< Skr. pratikṛ, Prakr. paḍiker-;

dūrker-, *duriker-*, 'to foretell'<Skr. dūrīkṛ. In stating dogmatically that Skr. sukṛta "would have become something like **sul*"—a word of singularly unGypsy-like appearance Prof. Turner assumes that intervocalic Skr. -t-, if it survives, must necessarily have become European Gypsy -l-; but it might equally well have become -r- (§ 130, No. 3), *e.g.* Skr. pat-:>Prākr. paḍ->Rom. *per-*, 'to fall,'; Skr. prefix prati->Prākr. paḍi->Rom. *pari-*.

Prof. Turner's second adverse criticism arises, I think, from a misapprehension of the scope and purpose of my book. When in my vocabulary, appended to Romani words of Indian origin, I cite Sanskrit, Prākrit, and Hindi forms, I do so with very different degrees of reverence. Sanskrit in almost every case is quoted as the source in which we find preserved the primitive form of Gypsy words, while Prākrit serves mainly to illustrate processes of sound-change which are often identical with those found in Romani. The Hindi words are in an entirely different category, and from the Gypsy viewpoint practically negligible. I supply them (as I explain in § 76) merely to indicate the usage in the central Modern Indian speech of to-day. But since the Gypsies had left India at least 200 years before the rise of Hindi and other vernaculars, these recent forms cannot have affected Romani.

Prof. Turner assumes that where the Hindi word is given by me I regard it in every instance as a true cognate. But this is not so. The distinction between tadbhavas (lineal descendants of Sanskrit words) and tatsamas (modern resuscitations from Sanskrit) is so well-known, and the examples in my vocabulary so obvious, that it would have been superfluous to have differentiated the two classes. He selects for rebuke (with judicious omissions which suggest that I try to connect a Romani word with a Hindi tatsama) the Gypsy *thulo*, 'fat.' In my vocabulary it appears thus: "*thulo*, adj. [Skr. sthūla, 'thick,' 'bulky,' 'gross'; Prākr. thulla; Hind. sthūl; Dard. tūla, tullo, tul, 'fat'}," where the Hindi sthūl stands out prominently as an unmistakable tatsama. Hindi being historically out of account, it seemed to me to be of first importance to the student of Gypsy to direct attention to the fact that an inherited word, which has survived in Romani, should have been lost and artificially restored in the Modern Indian vernaculars. Prof. Turner, writing as though my book were designed as a text-book on Modern Indian dialects rather than a work on comparative Romani, says: "Such an attitude and such mistakes invalidate the whole of [my] comparative work"—a remark which sheds a curious light on the attitude of the "Junggrammatiker."

JOHN SAMPSON.

The University,
Liverpool.

THE main ground of my criticism of Dr. Sampson's book was that in it he pays little regard to the principle of the constancy of sound-laws. In his reply, however, he professes his adherence to this principle; and proceeds forthwith to deny it. For by this method, he says, he arrived at the new conclusion, among others, that *bār*, 'stone,' is derived from Sanskrit *vaṭa*. It is true that initial *v-* regularly becomes *b*, and that intervocalic *-ṭ-* regularly becomes *r*. So far, so good. But it is a well-established law that in European Romani Skt. *ă* followed by one consonant only becomes *e*, as appears to be admitted by Dr. Sampson on p. 44 of his book. Therefore if *bār* is to be derived from *vaṭa*, a special explanation of the presence of *ā* (instead of *e*) is required: Dr. Sampson offers none, nor even indicates the need. He has already betrayed the principle of the constancy of sound laws Actually this word is derived from a Middle Indian **vaṭṭa-* (cf. Pali *vaṭṭo*, 'round, rolling'), common in the N.W. languages, *e.g.* Panjabi *waṭṭā*, which Khowar *bòrt* shows to be from earlier *varta-*.

I regret having seemed to ascribe to Dr. Sampson greater confidence in his etymology of *šukār* from *sukṛta-* than he expressed. by the words 'without hesitation' I intended to imply 'without directing attention to the phonetic irregularities involved in his etymology.' Nevertheless, he still stoutly upholds this etymology. But it behoves him, as a professed follower of the Junggrammatiker he sneers at, to explain why the word has *š* in all the dialects except the Greek (in which *ś* usually appears as *s*). He neither solves, nor even poses, the problem. The

retention of *-k-* he explains on the ground that it is an initial of the second member of a compound. That would be possible if the consciousness of its being a compound was retained up to the time when *-k-* ordinarily disappeared. But the support he gives for this contention is weak, and still further accuses him of deserting the principle of constancy. He derives *raker-*, 'to speak,' from *prakaroti* (which does not mean 'speak,' but 'accomplish'): yet the regular correspondence for Skt. *pr-* is Rom. *pr-* (Asiatic, Armenian, and perhaps English Rom. *p-*). He must therefore explain Engl. *r-*, Gk. *vr-* before he quotes this word in support, and this unfortunate lack not even Prof. Kuhn's "sehr glucklich" supplies. He derives *pariker-*, 'to thank,' from Skt. *pratikaroti*, but omits to explain why *a* appears instead of *e* in the first syllable. He derives *duriker-*, 'to foretell,' from Skt. *dūrīkaroti*, used by a scholiast on Pāṇini in the sense 'remove.' Obviously we have here not a descendant of Skt. *dūrīkaroti*, but a new Romani compound formed of two separate Romani words, *dur(i)* and *ker-*. Finally, he objects to my assumption that Skt. *-t-* would become *l*, and quotes *per-*, 'to fall,' from Skt. *patati*. *Per-* is not derived directly from Skt. *pátati*, but from Middle Indian **paṭati* (cf. Pkt. *paḍaï*), which has given rise to forms like Hindi *parnā*, while *pátati* is to be found in forms of the North-West, like Sindhi *pawaṇu*, Kashmiri *pyonu*.

In my review I quoted only one example of what I considered to be Dr. Sampson's neglect of the principle of the constancy of sound-laws, because in the space at my disposal I wished to deal with other and far more valuable aspects of his book. Nevertheless his pages abound in such examples. Lest I be accused of unfounded criticism, I select a few. *Niser-*, 'to go out,' said to be from Skt. *niṣkṛṣ-*, 'to drag out.' What has happened to the group *ṣk*, which becomes Middle Indian *kk*, and must remain in Romani as *k*? Skt. *niḥsarati*, 'he goes out,' provides a better etymology, which accords with Romani sound-laws. *Kam-*, 'to wish,' from *kāmayati*: yet *-m-* regularly becomes *v*; possibly from a form **kāmya-*, but probably borrowed from Persian *kām*, 'wish', Pehlevi *kāmītan*, 'to wish' *Kerav-*, 'to boil, from *kārayati*, 'to cause to do,' despite the fact that Skt. *ā* regularly remains Romani *a*. It is from a Middle Indian **kaṭhati* (cf Pali *kaṭhito*, 'boiled', Skt. *kvathati*, 'boils'). *Khino*, 'tired,' from Skt. *khinna-*, 'oppressed,' which would have given a Romani form with *χ-* Miklosich's derivation from *kṣīṇá-*, 'worn out,' is correct, for *kṣ* becomes *kh*. *Gōrō*, 'non-gypsy,' from Skt *guru-*, 'preceptor,' with irregular *ō* from *u*. why not (with regular phonetic change) from *gaura-*, 'light-complexioned' (cf. Hindī, *gorā*, 'European')? *Śon*, continental *con*, 'moon,' from *candra-*, with irregular *o* from *a*, an unlikely development of the group *ndr* not otherwise attested: it is from Skt. *jyotsnā*, Pkt. *jonhā*, which would regularly become Rom. *con*. *Thil-*, 'to hold,' is explained as derived from Rom. *ther-* (correctly attributed to Skt *dharati*), but *-r-* does not become *l*, nor does *e* normally become *i*: on the contrary *-t-* does become *l*, and *ṛ* does become *i*, so that *thil-* looks like a formation from *dhṛtá-*, the past participle which has furnished Modern Indian with many present stems. *Dud*, 'light,' from *dyota-*: but *dy* becomes *j*, and *-t-* becomes *l*. *Cārō*, 'bowl,' from *caru-*: but *a* becomes *e*; why not from **caṭṭa-*, H. *cāṭā*, 'bowl for sugarcane-juice'?

This part of Dr. Sampson's work is deserving of animadversion not because he makes mistakes in etymologies—that is, alas, the fate of all etymologers—but because in making them he does not pause to pose or to explain the phonetic irregularities involved. I say again that he has not been true to the principle of the constancy of sound-laws, and (what I did not say before) that he has as a necessary consequence been driven into guess-work. He upbraids me for not mentioning that his book is the first to supply a full and systematic series of the phonetic equations of Romani: I have tried to show that it does not do so.

The second point on which Dr. Sampson takes me to task is that I have wrongly accused him of comparing Sanskrit loanwords in Hindi with Romani words, as if they had been inherited Hindi words. He now says that it is clear that the Hindi words are borrowed, and not inherited; and he quotes § 76 in support. In this paragraph, however, there is no mention of *tatsama* or loanword, but only of Hindi cognates By that most comparative philologists will understand inherited words, not literary loanwords. Further, Dr. Sampson does not confine himself to quoting only loanwords in Hindi, but gives as many, if not more, inherited words. Thus in the passage whence I took the particular example (taken from Part I., p. 52, not from the vocabulary, "with judicious omissions," as Dr. Sampson suggests) we may read: "*t'an tχan*, 'place,' S sthāna, P. ṭhāṇa, H. thān; *t'ulo*, 'fat,' S. sthūla, P. thulla, H. sthūl." Of these two Hindi words, one, *thān*, is inherited and strictly to be called cognate; the other, *sthūl*, is a loanword. Dr. Sampson says that he knows this (though he does not explain what value, if any, the quotation of the literary loanword has); but is he right to assume that all his readers also will know? What, finally, is his principle of selection? Why does he compare in consecutive lines *thüd*, 'milk,' with H *dūdh* (inherited word), but *thuv*, 'smoke,' with H. *dhūm*, *dhūmā* (loanword). If it be, as he says above, "to direct attention to the fact that an inherited word, which has survived in Romani, should have been lost and artificially restored in the Modern Indian vernaculars," he is wrong; for the inherited word exists not only in the Hindi *dhuā̃*, but also in almost every other Modern Indo-Aryan language. There are, in fact, very few, if any, Romani words of Indo-Aryan origin which have not cognates in one or other of the living languages.

No one more regrets the necessity for this criticism of Dr. Sampson's work than myself: for as a description of a particular Romani dialect, and as a most useful collection of other material, it is pre-eminent, and puts all students of Indo-Aryan in general, and of Romani in particular, under a great debt of gratitude to the author. But if he thinks that I considered it "designed as a text-book on Modern Indian dialects," I say at once—μὴ γένοιτο.

R. L. TURNER.

Science and Psychical Research.

I BEG space for a short comment on Dr. Tillyard's remarks in NATURE of October 23, so far as they concern my letter which appeared in the issue of October 2. Dr. Tillyard misrepresented what I said when he wrote that I had given my own interpretation of the words "super-normal phenomena." These were his own words, chosen by me because I regarded them as better fitting this discussion than either "subjects of psychical research" or "spiritualism." For I am aware that although psychical research does certainly include the study of most, if not all, of the phenomena alleged by many to be referable to some 'spiritual' origin, there are many psychical researchers who do not accept this explanation of alleged communications between the living and the dead, but prefer to interpret such communications, and others

said to occur between living persons at a far distance from one another, by attributing them to an unknown power which was long ago named 'telepathy' by one of the founders of the Society for Psychical Research.

Dr. Tillyard, in his review of the "History of Spiritualism" in NATURE of July 31, says that psychical research purports to be the scientific study of what are called "super-normal phenomena"; and divides this study into two parts, calling the first 'physical,' the second 'mental.' In the mental part, however, are included practically all the various 'phenomena' known generally under the term 'spiritualistic.' Seeing that the present discussion has been mainly concerned with these phenomena, I desired to make it quite clear that I was dealing only with that department of psychical research which was concerned with such phenomena as may be strictly called 'ghostly.'

Touching Dr. Tillyard's call upon me to explain what 'trance' is, I reply that I do not know. But although he says he does not know the difference between trance and sleep he knows more than I do about this matter, for he states in NATURE of Aug. 28 that "Usually the medium is in deep trance and knows nothing of what is occurring." I have seen several 'occult' cases in which strange phenomena have occurred during a period when the medium, often invisible but sometimes not so, has been stated to be in trance, and have heard first-hand accounts of many similar cases. But I have never known or heard of any independent examination being made to test the medium's alleged condition. The phenomena produced at séances with trance mediums play an important part in the exhibitions of 'super-normal phenomena,' the reports of which excite popular curiosity and pervade the journalism of to-day.

BRYAN DONKIN.

I CAN find in Sir Arthur Conan Doyle's letter in NATURE of October 16 no explanation or withdrawal of his grave but, as I have shown, entirely untrue accusation that a statement that I made about him in the issue for September 25 was a "pure invention" on my part.

A. A. CAMPBELL SWINTON.

40 Chester Square, S.W.1,
October 16.

MAY I add to—and I hope end—my correspondence with Mr. Campbell Swinton by saying that I regret that I used the term "pure invention" in alluding to one of his statements, since his conclusion was a natural one with the information which he then had at his disposal.

ARTHUR CONAN DOYLE.

October 21.

The Electrical Charges from Like Solids.

THE uncertainty as to the charges arising on insulating solids when rubbed together has ever provided perplexities for the investigator and pitfalls for the lecturer. I have shown in previous papers (*Proc. Phys. Soc.*, 1915, and *Proc. Roy. Soc.*, 1917 and 1926) that a clean solid, say glass, may have entirely different qualities according to the previous treatment of the surface. Ordinary dirt, adsorbed films, temperature change, and, in particular, strain left on the surface by the rough pressure of other solids, are variables which vitally influence surface electrification.

In the present brief note I want to direct attention to the charges found when two *like* solids are rubbed or struck together. Ebonite is very convenient for the purpose. Two rods of this substance are cut from the same sheet and mounted with sealing wax in glass tubes which serve as handles. The free ends of the ebonite are thoroughly but *lightly* scraped with a razor blade and then boiled for a few seconds in water. After drying and cooling, the ebonite surfaces are ready for use. They behave as follows:

(1) Placing the rods across one another, one (A) is rubbed down the other (B). We find A charged $-^{ve}$, $B+^{ve}$. Discharge the rods over, *not in*, a flame. Rub B down A. We find B charged $-^{ve}$, $A+^{ve}$. Thus the rods are identical in behaviour, the 'rubber' in each case becoming $-^{ve}$, the 'rubbed' $+^{ve}$.

When the surfaces behave alike, as above, we call them 'standard.'

There is a real distinction between 'rubber' and 'rubbed,' a much smaller area of the former than of the latter taking part in the rub; and of the two, the rubber attains at the rubbing point a higher temperature. Hence, the rubber is more likely to yield and be greatly strained under the tangential forces applied in friction.

(2) Continued rubbing brings about a change of effect; the rubber, gradually losing its strong $-^{ve}$ quality, becomes first neutral and then more and more $+^{ve}$. When in the neutral condition, the rubber may be $-^{ve}$ or $+^{ve}$ according as the rub is light or heavy. Also at this stage it is sometimes possible to obtain one charge, say, $+^{ve}$, from a direct stroke, $-^{ve}$ from a reverse.

(3) By continuing the rubbing, the rubber becomes definitely $+^{ve}$ and remains so for the actual surface rubbed even after days of inaction. I propose to call the new state of surface, produced by rubbing, the 'strained' state.

(4) The strain can be removed by boiling the rods in water for a few seconds or more, according to the amount of strain. If both rods are considerably strained, it is possible by boiling each in turn for short periods to make first one, then the other $-^{ve}$, until finally both are restored to the pristine standard state of no strain. It should be remarked that after boiling the rods are allowed to cool before rubbing.

(5) If the rods have been brought by rubbing to the intermediate state (see (2) above), suppose one rod, A, is slightly $+^{ve}$ to B. Then warming A makes it $-^{ve}$ to B. Next, warming B makes it $-^{ve}$ to A again. The rise in temperature of the surface need be only, say, 50°, and can be done by the heat from a carbon glow lamp.

(6) Sharp glancing blows of one rod on the other, whether the surfaces be standard or strained, give rise generally to contrary, *but unequal*, charges on the rods. The sum total charge is $-^{ve}$. If these impacts are oft repeated the sum total charge may be very great, and each rod may be $-^{ve}$.

In all these experiments the charges are considerable and can be easily observed with a sensitive gold-leaf electroscope.

The above behaviour of ebonite is found also with like specimens of caoutchouc, celluloid, shellac, resin, sealing wax, paraffin wax, charcoal, sulphur, glass, mica. I have found no exceptions to the rule, but that remarkable solid, caoutchouc, reveals its idiosyncrasies, in triboelectricity as in other well-known phenomena, thermal and elastic. In caoutchouc the rubber has a $+^{ve}$, not a $-^{ve}$, tendency due to rise in temperature.

Each material must be rendered standard as defined in (1) above, but the dual process of scraping and boiling, adopted with ebonite, is clearly not universally applicable.

From the above experiments three general principles, which I think are new, emerge:

(*a*) *Really identical surfaces charge one another according to a definite rule* (*Expt.* 1).

(*b*) *Friction between initially identical surfaces causes these to become strained, the strain being revealed by the nature of the charges arising, and by the fact that heating restores the surface* (*Expt.* 2, 3, 4, 5).

(*c*) *Rough impact between like bodies in general leaves them with unequal charges* (*Expt.* 6).

The earliest lessons inculcated in text-books on electricity are: first, that, to produce charges by rubbing, the two solids used must be different in nature; secondly, that the two charges are equal in amount and opposite in sign.

Both these principles, as we see, are erroneous, although the second one is true for the special case when the two solids are slowly rubbed, and not struck, together. In ebonite we find, after impact, a net - ^{ve} charge The equal + ^{ve} charge has therefore escaped to the air.

There is food for reflection in these results. Since solids of like chemical, and even physical, nature can charge one another, we have hope of explaining all those baffling results so well known to all who have carefully experimented in contact electrification. For these results show that the physical state of a solid surface, being liable to great variation, is a factor of prime importance.

If small defilements, or strains, or temperature changes be imposed on the surface, they concentrate just where, on the actual superficies, their influence may fundamentally affect the surface characteristics. Some investigators in the past, finding erratic results, losing patience, have even dared to describe the effects as 'fortuitous.'

No sound information in this subject can be garnered unless the specimens used are carefully cleaned and otherwise prepared.

Two rods of any insulator, *e.g.* glass, ebonite, caoutchouc, cut from the same sheet, and merely wiped with a duster, are almost invariably different in surface qualities; on rubbing, one will charge + ^{ve}, the other − ^{ve}.

There is one interesting speculation deducible from the principles enunciated above. The old problem as to the genesis of electric sand storms and dust storms in Nature may find a solution from the two principles (*a*) and (*c*). For here we have like particles striking together and giving rise to a net charge on the particles and an opposite charge in the air.

This class of research is simple-seeming. But those who have spent time on the subject will allow that it is very baffling, those who have not done so, will at least remember that despite great efforts by physicists the subject has not yet passed the pioneer stage. The most important point in the technique is the production of a standard surface for the material used. Then if, in any experiment, effects become involved or difficult of interpretation, it is easy to reproduce the standard surface and begin again. This principle is emphasised in a recent paper by Mr. Jex and myself (*Proc. Roy. Soc.*, June 1926). P. E. SHAW.

University College,
Nottingham.

Origin of Yolk in the Eggs of Scolopendra.

IN a previous paper (*Proc. Camb. Phil Soc. Biol. Sci.*, October 1924) on the eggs of the centipede, *Lithobius forficatus*, one of us (V. N.) described two kinds of yolk, albuminous and fatty. The albuminous yolk is preceded by nucleolar extrusions of a remarkable type, and its origin seems to be associated with them, although no evidence could be adduced that they are *directly* transformed into the albuminous yolk. It was further shown that the juxta-nuclear Golgi apparatus fragments into small granules and small crescent-shaped Golgi elements. The former grow in size and give rise to the fatty yolk.

Miss S. D. King (*Scientific Proc. Roy. Dub. Soc.*, vol. 18) confirms the above account of the association of the albuminous yolk with the nucleolar extrusions, but in her opinion the albuminous yolk arises directly from the nucleolar extrusions. With regard to the Golgi apparatus, she admits that it fragments into small granules. Furthermore, she describes fatty yolk, but "the origin of this fatty yolk is doubtful, but it may possibly be connected with the Golgi apparatus, although no evidence in support of this theory has been discovered." In our opinion Miss S. D. King is doubtful about the origin of fatty yolk from the Golgi apparatus, because "both Mann-Kopsch and Da Fano material was studied, but the latter gave such favourable results that it was used *almost exclusively*" (italics ours). Now, it is well known that the Da Fano method fails to show fat in finished slides, while the Golgi apparatus is preserved. On the other hand, the Mann-Kopsch method preserves both Golgi apparatus and fat, and thus enables one to study the transformation of the former into the latter. Furthermore, Flemming-without-acetic, which Miss King has used, shows fat, but not the Golgi apparatus, at least in the egg of Lithobius.

In view of the above conflicting evidence, it was thought desirable to work out the origin of yolk in the eggs of the centipede, Scolopendra. Our observations on the eggs of this centipede strongly confirm the earlier observations of one of us on *Lithobius forficatus*. At the very beginning of the growth period of the egg of Scolopendra, the nucleolus buds off round bodies into the cytoplasm. This process lasts for some time, until at a particular stage it ceases and the nucleolar extrusions in the cytoplasm completely disappear. The extrusions do not fragment in the cytoplasm as they do in the case of *Lithobius forficatus*. After the disappearance of the extrusions there is a long pause; later, albuminous yolk puts in its appearance, and seems to arise *de novo* in the cytoplasm, as is the case in spiders (Von Bambeke, *Arch. de Biol.*, 1897, and Nath, NATURE, May 15, 1926), although the possibility remains that the material of the nucleolar extrusions which have disappeared may contribute towards the formation of the albuminous yolk. At this stage the egg has assumed a large size and the nucleus lies just below the egg membrane. The mitochondria are granular and form a ring all round the nucleus in the youngest egg, which, however, is thicker on one side. They increase in number and ultimately fill up the whole egg.

The behaviour of the Golgi apparatus is remarkable. In the youngest eggs it consists of a few juxta-nuclear rings and crescents. In Mann-Kopsch preparations the rings appear like vacuoles with a sharp chromophilic rim and a central chromophobic area (idiosome). The crescents also show a distinct idiosome material. The Golgi elements increase in numbers, so much so that the whole egg is full of them. The vacuole-like Golgi rings swell up and are directly transformed into the fatty yolk spheres which contain free unsaturated fat, as is shown by their blackening in Flemming-without-acetic, and their quick decolorisation in turpentine, both after Mann-Kopsch and F. W. A. When the fatty yolk spheres are blackened by osmic acid they appear solid, but when they are being decolorised in turpentine they appear like vacuoles with a black rim and clear contents exactly like the Golgi rings. Gradually the black rim also becomes colourless and the sphere remains as a clear white vacuole. An exactly similar process takes place in the eggs of spiders also. Furthermore, we find that the fatty yolk spheres are never smaller than the Golgi rings,

as should be the case if they were to arise *de novo*. Again, they appear only after the Golgi rings have increased both in numbers and size.

Lastly, we wish to emphasise the fact that in all eggs in which the Golgi apparatus is said to give rise to yolk (for reference see NATURE, May 15, 1926), such yolk is *always* fatty. This in itself is confirmatory of the above view, because the Golgi material is supposed to be a lipoid combined with a proteid.

A full account will be published later.

VISHWA NATH.
(Bhupindra Research Laboratory, Patiala.)
TASDIQUE HUSAIN.
(Government College, Lahore.)
Central Research Institute,
Kasauli (India),
September 9.

Kammerer's Alytes.

MAY I be permitted to reply briefly to Dr. Noble's letter on Kammerer's Alytes which appeared in NATURE of October 9? There are several questions involved: first, whether Dr. Noble was right in his statement to the British Association in 1925, that Kammerer's specimen did not show a genuine nuptial pad, because the characteristic glands were absent, and that the glands, not the spines, were diagnostic of these pads.

Champy, in his paper on the subject, states that the nuptial glands are merely the normal skin glands enlarged, and this is confirmed by Dr. Przibram's letter to NATURE of August 7.

Secondly, Dr. Noble makes the statement that the glands in Kammerer's controls shown in America were the same size as those in the sections of the pad.

This statement I can readily accept. I have photographs before me as I write both of Kammerer's earlier sections, sent to Bateson in 1919, and of his later ones exhibited in Cambridge in 1923. In the former the cornification of the epidermis is not so strongly developed as in the latter, and the disparity in size between the glands in the sections through pad and control is slight. In the latter, as stated, the glands in the pad are double the size of those in the control and the cornification is very strong. Kammerer obtained many of the modified males and reared them through several generations, and the acquired peculiarities became intensified in later generations.

As to the date at which the Alytes specimen was 'faked,' there are two passages in Dr. Noble's description which completely give his case away. His letter suggests that Dr. Kammerer perpetrated a wicked fraud on the scientific world. Dr. Noble could find no spines on the specimen in Vienna, and saw blackened patches on *both* hands: I saw spines and have a photograph of them, and on one of the hands I saw no blackened patch whatever.

Dr. Noble's reference to the large-eyed Proteus shows that he fails to grasp its bearing on the question. I consider it the most wonderful object ever exhibited to a scientific audience. The larval Proteus does not, as Dr. Noble suggests, possess an eye: it has, like other blind cave-animals, only the embryonic rudiment of one. If Dr. Noble can find other 'casual' examples of blind cave-animals developing large eyes, I shall be glad to hear of them.

Both the Alytes and the Proteus specimens are examples of the same phenomenon—a phenomenon termed by Prof. Semon 'ecphory'; that is, the revival of ancestral features by the reinstating of the ancestral environment. This process required for its completion five or six generations in Alytes and in Proteus only one, but it is essentially the same thing in both; and to try to represent the skilled experimenter who produced the Proteus as a clumsy trickster seems to me to be both unjust and unworthy.

I do not propose to discuss the merits of the inheritance of acquired characters in the present issue, but as Dr. Noble seems unconscious of the rising tide of Lamarckism, let me point out that Kammerer's conclusions are being confirmed by workers dealing with quite different animals, the last and most spectacular of these confirmations being the paper on the inheritance of habit by rats, read at the Oxford meeting of the British Association by Prof. William McDougall.

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E. W. MACBRIDE.
Royal College of Science,
South Kensington, S.W.7.

The Anomalous Flocculation of Clay.

SOME further experiments have been performed in these laboratories which clear up the discrepancies between the experiments described in a previous letter on the above subject (NATURE, May 1, p. 624) and those of Messrs. Kermack and Williamson (NATURE, June 12, p. 824).

The following table gives the times required to flocculate a 0·1 per cent. purified clay suspension at various concentrations of sodium and calcium chlorides and hydroxides:

Concn Ca'' ion.	Time required for flocculation.		
	$Ca(OH)_2$.	$CaCl_2$	Two equivalents of chlorides to one of hydroxide.
0·001	7 hours	14 min.	6 hours
0·002	28 min.	10 ,,	32 min.
0·003	2 ,,	7 ,,	12 ,,
0·004	1·5 ,,	6 ,,	4·5 ,,
0·005	1·5 ,,	6 ,,	3·5 ,,
0·010	1·5 ,,	6 ,,	1·5 ,,
0·014	1·5 ,,	6 ,,	1·5 ,,
Concn Na ion.	NaOH	NaCl	NaCl : NaOH = 2 : 1.
0·05	2 hours	13 min.	2 hours
0·1	32 min.	13 ,,	32 min.
0·2	22 ,,	14 ,,	24 ,,
0·5	20 ,,	17 ,,	17 ,,
0·9	15 ,,	18 ,,	14 ,,

These results show that calcium hydroxide is a less powerful coagulant than calcium chloride, and actually tends to stabilise a suspension containing the latter salt, provided that the time of flocculation is longer than about twelve minutes.

If the concentration is such that coagulation takes place in 6 minutes or less, then calcium hydroxide flocculates more rapidly than the chloride at equivalent concentrations.

The results for sodium, on the other hand, suggest that even this latter effect should not be called anomalous, as at a concentration 0·9 normal, sodium

(*b*) *Friction between initially identical surfaces causes these to become strained, the strain being revealed by the nature of the charges arising, and by the fact that heating restores the surface* (*Expt.* 2, 3, 4, 5).

(*c*) *Rough impact between like bodies in general leaves them with unequal charges* (*Expt.* 6).

The earliest lessons inculcated in text-books on electricity are: first, that, to produce charges by rubbing, the two solids used must be different in nature; secondly, that the two charges are equal in amount and opposite in sign.

Both these principles, as we see, are erroneous, although the second one is true for the special case when the two solids are slowly rubbed, and not struck, together. In ebonite we find, after impact, a net $-^{ve}$ charge. The equal $+^{ve}$ charge has therefore escaped to the air.

There is food for reflection in these results. Since solids of like chemical, and even physical, nature can charge one another, we have hope of explaining all those baffling results so well known to all who have carefully experimented in contact electrification. For these results show that the physical state of a solid surface, being liable to great variation, is a factor of prime importance.

If small defilements, or strains, or temperature changes be imposed on the surface, they concentrate just where, on the actual superficies, their influence may fundamentally affect the surface characteristics. Some investigators in the past, finding erratic results, losing patience, have even dared to describe the effects as 'fortuitous.'

No sound information in this subject can be garnered unless the specimens used are carefully cleaned and otherwise prepared.

Two rods of any insulator, *e.g.* glass, ebonite, caoutchouc, cut from the same sheet, and merely wiped with a duster, are almost invariably different in surface qualities; on rubbing, one will charge $+^{ve}$, the other $-^{ve}$.

There is one interesting speculation deducible from the principles enunciated above. The old problem as to the genesis of electric sand storms and dust storms in Nature may find a solution from the two principles (*a*) and (*c*). For here we have like particles striking together and giving rise to a net charge on the particles and an opposite charge in the air.

This class of research is simple-seeming. But those who have spent time on the subject will allow that it is very baffling; those who have not done so, will at least remember that despite great efforts by physicists the subject has not yet passed the pioneer stage. The most important point in the technique is the production of a standard surface for the material used. Then if, in any experiment, effects become involved or difficult of interpretation, it is easy to reproduce the standard surface and begin again. This principle is emphasised in a recent paper by Mr. Jex and myself (*Proc. Roy Soc.*, June 1926). P. E. SHAW.

University College,
Nottingham.

Origin of Yolk in the Eggs of Scolopendra.

IN a previous paper (*Proc Camb Phil Soc Biol Sci.*, October 1924) on the eggs of the centipede, *Lithobius forficatus*, one of us (V N) described two kinds of yolk, albuminous and fatty. The albuminous yolk is preceded by nucleolar extrusions of a remarkable type, and its origin seems to be associated with them, although no evidence could be adduced that they are *directly* transformed into the albuminous yolk. It was further shown that the juxta-nuclear Golgi apparatus fragments into small granules and small crescent-shaped Golgi elements. The former grow in size and give rise to the fatty yolk.

Miss S. D. King (*Scientific Proc. Roy. Dub. Soc.*, vol. 18) confirms the above account of the association of the albuminous yolk with the nucleolar extrusions, but in her opinion the albuminous yolk arises directly from the nucleolar extrusions. With regard to the Golgi apparatus, she admits that it fragments into small granules. Furthermore, she describes fatty yolk, but "the origin of this fatty yolk is doubtful but it may possibly be connected with the Golgi apparatus, although no evidence in support of this theory has been discovered." In our opinion Miss S. D. King is doubtful about the origin of fatty yolk from the Golgi apparatus, because "both Mann Kopsch and Da Fano material was studied, but the latter gave such favourable results that it was used *almost exclusively*" (italics ours). Now, it is well known that the Da Fano method fails to show fat in finished slides, while the Golgi apparatus is preserved. On the other hand, the Mann-Kopsch method preserves both Golgi apparatus and fat, and thus enables one to study the transformation of the former into the latter. Furthermore, Flemming-without-acetic, which Miss King has used, shows fat, but not the Golgi apparatus, at least in the egg of Lithobius.

In view of the above conflicting evidence, it was thought desirable to work out the origin of yolk in the eggs of the centipede, Scolopendra. Our observations on the eggs of this centipede strongly confirm the earlier observations of one of us on *Lithobius forficatus*. At the very beginning of the growth period of the egg of Scolopendra, the nucleolus buds off round bodies into the cytoplasm. This process lasts for some time, until at a particular stage it ceases and the nucleolar extrusions in the cytoplasm completely disappear. The extrusions do not fragment in the cytoplasm as they do in the case of *Lithobius forficatus*. After the disappearance of the extrusions there is a long pause; later, albuminous yolk puts in its appearance, and seems to arise *de novo* in the cytoplasm, as is the case in spiders (Von Bambeke, *Arch. de Biol.*, 1897, and Nath, NATURE, May 15, 1926), although the possibility remains that the material of the nucleolar extrusions which have disappeared may contribute towards the formation of the albuminous yolk. At this stage the egg has assumed a large size and the nucleus lies just below the egg membrane. The mitochondria are granular and form a ring all round the nucleus in the youngest egg, which, however, is thicker on one side. They increase in number and ultimately fill up the whole egg.

The behaviour of the Golgi apparatus is remarkable. In the youngest eggs it consists of a few juxta-nuclear rings and crescents. In Mann-Kopsch preparations the rings appear like vacuoles with a sharp chromophilic rim and a central chromophobic area (idiosome). The crescents also show a distinct idiosome material. The Golgi elements increase in numbers, so much so that the whole egg is full of them The vacuole-like Golgi rings swell up and are directly transformed into the fatty yolk spheres which contain free unsaturated fat, as is shown by their blackening in Flemming-without-acetic, and their quick decolorisation in turpentine, both after Mann-Kopsch and F. W. A. When the fatty yolk spheres are blackened by osmic acid they appear solid, but when they are being decolorised in turpentine they appear like vacuoles with a black rim and clear contents exactly like the Golgi rings. Gradually the black rim also becomes colourless and the sphere remains as a clear white vacuole. An exactly similar process takes place in the eggs of spiders also. Furthermore, we find that the fatty yolk spheres are never smaller than the Golgi rings,

as should be the case if they were to arise *de novo*. Again, they appear only after the Golgi rings have increased both in numbers and size.

Lastly, we wish to emphasise the fact that in all eggs in which the Golgi apparatus is said to give rise to yolk (for reference see NATURE, May 15, 1926), such yolk is *always* fatty. This in itself is confirmatory of the above view, because the Golgi material is supposed to be a lipoid combined with a proteid.

A full account will be published later.

VISHWA NATH.
(Bhupindra Research Laboratory, Patiala.)
TASDIQUE HUSAIN.
(Government College, Lahore.)
Central Research Institute,
Kasauli (India),
September 9.

Kammerer's Alytes.

MAY I be permitted to reply briefly to Dr. Noble's letter on Kammerer's Alytes which appeared in NATURE of October 9? There are several questions involved: first, whether Dr. Noble was right in his statement to the British Association in 1925, that Kammerer's specimen did not show a genuine nuptial pad, because the characteristic glands were absent, and that the glands, not the spines, were diagnostic of these pads.

Champy, in his paper on the subject, states that the nuptial glands are merely the normal skin glands enlarged, and this is confirmed by Dr. Przibram's letter to NATURE of August 7.

Secondly, Dr. Noble makes the statement that the glands in Kammerer's controls shown in America were the same size as those in the sections of the pad. This statement I can readily accept. I have photographs before me as I write both of Kammerer's earlier sections, sent to Bateson in 1919, and of his later ones exhibited in Cambridge in 1923. In the former the cornification of the epidermis is not so strongly developed as in the latter, and the disparity in size between the glands in the sections through pad and control is slight. In the latter, as stated, the glands in the pad are double the size of those in the control and the cornification is very strong. Kammerer obtained many of the modified males and reared them through several generations, and the acquired peculiarities became intensified in later generations.

As to the date at which the Alytes specimen was 'faked,' there are two passages in Dr. Noble's description which completely give his case away. His letter suggests that Dr. Kammerer perpetrated a wicked fraud on the scientific world. Dr. Noble could find no spines on the specimen in Vienna, and saw blackened patches on *both* hands: I saw spines and have a photograph of them, and on one of the hands I saw no blackened patch whatever.

Dr. Noble's reference to the large-eyed Proteus shows that he fails to grasp its bearing on the question. I consider it the most wonderful object ever exhibited to a scientific audience. The larval Proteus does not, as Dr. Noble suggests, possess an eye: it has, like other blind cave-animals, only the embryonic rudiment of one. If Dr. Noble can find other 'casual' examples of blind cave-animals developing large eyes, I shall be glad to hear of them.

Both the Alytes and the Proteus specimens are examples of the same phenomenon—a phenomenon termed by Prof. Semon 'ecphory'; that is, the revival of ancestral features by the reinstating of the ancestral environment. This process required for its completion five or six generations in Alytes and in Proteus only one, but it is essentially the same thing in both; and to try to represent the skilled experimenter who produced the Proteus as a clumsy trickster seems to me to be both unjust and unworthy.

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If Dr. Noble will forgive me for lapsing into his own expressive American, let me gently entreat him "to get on the band-waggon." Habit as the chief factor in evolution and the inheritability of acquired habits are accepted by leading systematists, palæontologists, and embryologists. Every year adds to the recruits, and I hope that Dr. Noble will join them. If he does, I am sure that he will "get the bulge" on many of his countrymen.

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These results show that calcium hydroxide is a less powerful coagulant than calcium chloride, and actually tends to stabilise a suspension containing the latter salt, provided that the time of flocculation is longer than about twelve minutes.

If the concentration is such that coagulation takes place in 6 minutes or less, then calcium hydroxide flocculates more rapidly than the chloride at equivalent concentrations.

The results for sodium, on the other hand, suggest that even this latter effect should not be called anomalous, as at a concentration 0·9 normal, sodium

hydroxide was definitely a better flocculant than sodium chloride, while with the chloride-hydroxide mixture, this effect started at a concentration of 0·5 normal.

A preliminary experiment with a 0·1 per cent. suspension of highly purified amorphous silica gave the following results :

	Concentration required to flocculate in 1 hour.	
	Sodium.	Calcium.
Chloride .	No flocculation in 10 hr. in 1 *N* solution	No flocculation in 10 hr. in 1 *N* solution
Hydroxide .	0·13 *N*	0·0015 *N*.

Thus both sodium and calcium hydroxides were far better flocculants than the corresponding chlorides. The writer suggests that if the term 'anomalous' must be used, it should be applied to the coagulation of silica by electrolytes rather than to the coagulating powers of calcium and sodium salts.

H. B. OAKLEY.

Wellcome Tropical Research Laboratories,
Khartoum, September 20.

The Anomalous Dilatation of Invar.

IN *Arkiv f. Mat., Astron. o. Fysik*, vol. 19 B (1925), Messrs. C. Benedicks and P. Sederholm gave a short account of dilatation measurements of invar in which they claim to have found a new property of this well-known material. Raising the temperature of an invar wire quickly by 50°, they find the coefficient of expansion has sensibly the normal value, *i.e.* 13×10^{-6}, at the first moment of heating. After 3 minutes a contraction sets in, a steady state being reached after 12 minutes.

In order to repeat their experiment, I cut a strip $120 \times 1{\cdot}5 \times 1$ mm. from an old piece of invar forged out to 1 mm. thickness, and drew this into a wire of diameter 0·5 mm., 60 cm. long. This was clamped at one end, stretched with a force of 1 kgm. or less by a spiral spring at the other end, and heated to 50° C. by passing a current through it. A micrometer microscope focussed on a scratch near the free end enabled changes of length to be measured to within 1μ.

No trace of the new effect was found. The wire took its final length in any case 10 sec. after starting the current, as well as after cutting it off. The cold drawn wire contracted 10μ on heating ; after annealing at a red heat it expanded 6μ (coefficients approximately $0{\cdot}5 \times 10^{-6}$ resp. $+0{\cdot}3 \times 10^{-6}$), which shows that the wire was indeed the best quality of invar.

The above-mentioned authors detected by metallographic methods the existence of a second phase in invar, and then looked for an effect of a possible heterogeneous transformation on the thermal expansion. May I suggest that such an effect was found long ago by the exhaustive researches of M. Guillaume, in the form of a small thermal hysteresis which lasts for half an hour at 100° and a few days at 40° ? These times would seem more probable for a transformation in the solid state than 12 min. at room temperature.

As Mr. Benedicks used a wire only 8 cm. long, it may well be that a lag of some kind in his measuring arrangement—about which he gave no details—is responsible for his result.

F. ZERNIKE.

Physical Laboratory,
The University,
Groningen.

Biological Research in the Tropics.

DURING the months July to September this year I was enabled to do some research work on protozoan parasites at the Imperial College of Tropical Agriculture in Trinidad, B.W.I., thanks to the generosity of the governing body in granting me free facilities there.

As I feel that the possibilities of the College as a centre for tropical research are not sufficiently known to biological workers at home, I venture to direct attention to the fact that for research workers in almost any branch of tropical biology, there is no more convenient place for headquarters than the College. Though, of course, its teaching activities deal more exclusively with agriculture, the governing body and the Principal, Dr. Leake, were most generous in allowing me facilities for prosecuting my research, which was not connected directly with agriculture.

At the present time the only tropical research laboratory easily accessible to British workers is the one at Kartabo, British Guiana, run by Mr. Beebe under the auspices of the New York Zoological Society. Trinidad has the advantage of involving a shorter journey, and the biological worker will find large laboratories, which will soon be very well equipped, thanks to the new government grant. But, of course, the main point of importance to the biologist in the tropics would be the abundance of tropical forms, and here Trinidad compares favourably with other West Indian islands, as it is the most tropical of them all, and the flora and fauna are more South American than West Indian in affinities. There are large tracts of primitive forest which are under government control and form wonderful collecting grounds.

To a worker who can spend only a short time in the tropics, the presence of an expert staff such as that at the Imperial College of Tropical Agriculture can be invaluable, especially when backed by the valuable entomological, etc., collections which the College possesses. The College works in happy unison also with the Department of Agriculture, where again one found the most able and ready assistance on the part of the local experts, including my friend Mr. Urich, who possesses an unrivalled knowledge of the island fauna.

On these grounds, and on others which are too numerous to enumerate here, I wish strongly to urge that biologists who desire to do tropical research could not do better than obtain permission to work at this College, permission which, I have no doubt, will be granted in all suitable cases.

J. S. DUNKERLY.

The University, Manchester.

Magnetic Storms and Wireless Communication.

IT was reported a few days ago that communication with Canada, by the new beam system of rays of short wave-length, had been completely blocked by a magnetic storm. Why should this be ? The fluctuations of magnetic force are but slight, and one might expect the rays to arrive by an altered path. May we assign a deeper and more fundamental cause ? That the magnetic storm is itself due to an incursion of free electrons into the upper atmosphere, in such numbers as to upset all the ray-paths and twist them out of regularity. The number of foreign electrons need not be very great. The only alternative seems to be oscillation of the magnetic field, so rapid as to be comparable with the time of transit of the ray : which is very unlikely.

JOSEPH LARMOR.

Cambridge, October 26.

Aspects of Physical and Mental Inheritance.[1]

By Prof. R. RUGGLES GATES.

ONE of the most striking facts in modern biology is the discovery that hereditary differences commonly behave as independent fixed units, handed on generation after generation according to various characteristic but simple laws. The differences so transmitted may be large or they may be very minute, but they in some way maintain their identity throughout the welter of events which constitute the passage from one generation of adults to another: that is, the maturation of the germ cells and the development of the individual. Clearly a physical difference maintained in successive generations among individuals developing in the same environment must be due to an initial difference in the germinal material. Such differences are, moreover, as a rule equally inherited through either the egg or the sperm in crosses. The only structural materials in the germ cells of higher organisms which fulfil these requirements for transmission are the chromosomes.

These minute bodies in the nucleus evidently constitute the essential nexus between generations, in so far as the widespread Mendelian differences are concerned, but in plants certain characters may be controlled by plastids in the cytoplasm. It has furthermore been proved in certain plants and animals that visible differences in the chromosomes are accompanied by external differences in the resulting organism. Just as the cell theory of organic structure long ago emerged into fact, so the chromsome theory of inheritance has become a fact. This does not mean, however, that the chromosomes alone are concerned in inheritance.

An abundance of evidence from many sources leads to the view that the chromosome is a complicated structure composed of smaller units. The theory that these units or genes are arranged in linear fashion in the chromosomes, has been connected chiefly with the name of Morgan, because of his extensive studies of heredity and mutation in the fruit-fly, Drosophila; but its origin is really much older. While this theory of linear arrangement is not yet established, it may be said that no other reasonable theory has yet been put forward to explain the phenomena of crossing-over which have been so extensively investigated in this fly, and to a lesser extent in various other organisms.

We have, then, a picture of the chromosomes as containing large numbers of differentiated areas or groups of particles which, while in the uncompacted state, activate and control or determine the growth and differentiation of the cytoplasm and hence the development of the individual. Such conceptions are necessary to explain the unitary behaviour in inheritance of innumerable characteristics in man as well as in other organisms.

While, however, the units must be abstracted and considered separately for purposes of investigation, yet they form the elements of an extraordinarily complicated system and they cannot exist apart from it. Eyes may be blue or brown, and the difference is inherited as a unit, but the blue eye can only develop as a part of the whole system to which it belongs.[2] Here I am in fundamental agreement with the views expressed by Dr. Myers. Just as the developed character cannot exist apart from the organism to which it belongs —you cannot separate the serration from a leaf margin or the shape of the nose from that organ—so in the germplasm the various structural elements making up the configuration, though each produces its own effect through chemical action or structural arrangement, are interdependent in the system to which they belong. Mendelian inheritance consists in the substitution of one such unit for another which occupies the corresponding position in the architecture of the germplasm.

The phenomena of heredity are made possible by these structural arrangements within the organism, the body being composed of cells each with its nucleus, that nucleus containing two sets of chromosomes of corresponding structure, one derived from each parent. Thus are we woven out of the warp and woof derived by mitotic division from two parental sex cells, making a garment infinitely finer in texture and more intimately blended in its structural elements than any fabric. Yet the fact remains that these elements maintain their identity and usually segregate out again sharply when new germ cells are formed.

The orderliness of development in its minutest details, the interrelations and interfunctionings of the chemical and structural elements as they arise, impress every biologist deeply with their regularity and stability. The phenomena of individual development are thus as remarkable in some respects as those of evolution itself. In heredity all these potentialities of the organism must pass over the very narrow bridge of the two germ cells, one of which contributes little more than a nucleus. How this miracle of orderly development is accomplished we can only dimly picture in detail. But the ubiquitous facts of heredity continually emphasise the amazing orderliness of development.

It is sometimes stated that the clear-cut segregation which is so characteristic of Mendelian heredity applies only to abnormalities, and that normal racial and specific differences do not follow such laws. The fact that related species often differ visibly in their chromosome equipment certainly leads to many departures which may more or less completely obscure Mendelian phenomena in crossing. De Vries formerly took up the position that species and varieties differ in their behaviour on crossing. But there is nothing in the more recent work to show that such differences as exist are really fundamental in our present point of view, although they are certainly important. Variety differences are often single sharp units, while specific differences are more apt to represent accumulations of many, often multiple, differences, or chromosome differences which have come about in other ways than by simple Mendelian mutations. Interspecific sterility,

[1] Contribution to a joint discussion on "Heredity in its Physical and Mental Aspects," before Sections D (Zoology), H (Anthropology), and J (Psychology) of the British Association at Oxford on August 9.

[2] That this does not necessarily include the whole organism is shown by the recent tissue culture work of Strangeways and Fell, in which eye rudiments excised from embryo chicks continued their development.

however, all too frequently prevents crosses being made from which evidence of the nature of the differences could be obtained. There is some evidence, however, both in animals and plants, that in related species the germplasm is similarly constituted.

In the case of man, there is no evidence that the process of inheritance of racial characters differs in any important respect from that of abnormalities. In eye colour—a typical racial character—blue and brown have long been regarded as a Mendelian pair, and while different degrees of brown exist, there is evidence that each segregates sharply from blue. In my book "Heredity and Eugenics" the inheritance of a large number of abnormalities was considered, each following its own Mendelian law.

More recently I have considered the inheritance of racial differences[3] in man. Here multiple factors appear often to be characteristic, as in skin colour and stature. But everything indicates that inheritance of stature and cephalic index follows the same rules as the inheritance of size and shape in other organisms. Present knowledge indicates that the size factors in man differ in no important respect from those of rabbits or even of plants. Moreover, there is every indication that in interracial crosses, where stature and cephalic index are usually regarded as racial diagnostic features, the laws of inheritance of these differences are exactly the same as within a single human family. The more recent investigations indicate that far too much importance has been attached to cephalic index as a racial character, and the same is true to a lesser extent of stature. But it will be some time before a satisfactory analysis of head shape in terms of size and shape factors can be attempted.

Turning now for a moment to mental inheritance, I do not propose to discuss any of the philosophical views of the relations between mind and body, although I am inclined to adopt some such interpretation as that of Lloyd Morgan, namely, that the life of the organism can equally be viewed as a system of physiological or of mental events, without solving or attempting to solve the problem of their interrelations the one to the other. But from the biological point of view, as Prof. Dendy wrote, "It is only in so far as they are related to the brain [I should prefer to say the nervous system] that the discussion of the inheritance of mental characters can have any meaning." The analogy which is sometimes drawn between heredity and memory is really an attempt to explain the less obscure by comparison with the more obscure, or from the point of view just expressed it represents a jump from the physiological to the mental interpretation instead of adhering consistently to one or the other.

In one sense mental and physical inheritance are on exactly the same basis, for in both cases inheritance can only be determined by comparing parents with offspring or the latter with each other, and noting similarities and differences. Such comparisons lead to the clearest evidence of mental inheritance. But it should be recognised that observation of the fact of inheritance is one thing and explanation of how it comes about is quite another. Owing to the difficulty of defining and determining mental characters, progress in the study of mental inheritance has been retarded. Probably few psychologists would now deny the fact of mental inheritance, but biologists must look to them for an analysis of the mind which will enable us to determine what are the units which are really being inherited. Psychologists themselves are only beginning to consider these questions. McDougall's work has been most useful in the preliminary analysis of mental differences from a biological point of view.

When Galton began his studies of mental inheritance the faculty psychology was current, and he naturally made use of its conceptions. But now that the conception of the mind as made up of faculties has become obsolete and various other methods of analysis have taken its place, we still need an analysis of the mind which will be more biological in its characterisation. McDougall writes of the "structure of the mind," but scarcely in the sense in which a biologist would hope to see the term used.

There appear to be two possible lines of approach to a biological analysis of the mind from an hereditary point of view: (1) By the study of mental evolution; (2) by comparison of the mentality of related individuals. As regards mental evolution, the study of animal behaviour shows that increasing complexity of the nervous system is paralleled by increasing mental complexity or powers of reaction. This is clear to any one who compares, for example, a Paramœcium, a starfish, and an ape. Elliot Smith has pointed out in some detail how the mental evolution of man himself has taken place through increasing complication in the structure of the fore-brain. The mind has become an instrument for the recognition, confluence and co-ordination of relationships.

That many mental differences are the result of germinal variations arising in the nervous system is indicated by such extreme cases as (*a*) tumbler pigeons, (*b*) a race of goats which becomes partially paralysed when frightened,[4] and (*c*) in man, feeble-mindedness. It is questionable in how far any other source of mental variations is required to explain mental evolution. The cases cited are semi-pathological, but the smaller, normal differences which have been less studied are likely to show similar origin and hereditary behaviour.

There are no doubt many ways in which the human mind can be analysed and its elements classified; but I believe it will be found with mental, as with physical, inheritance that the only way to determine what are the inherited units is by comparing the mentality of parents with that of their children and relatives. The difficulties of such comparison are of course increased by the facts of proximity and imitation. But the *differences* which appear will often be more significant than the similarities. We have already seen that studies of physical heredity require that the organisms should develop in a similar environment. Obviously the same is true of mental inheritance; but as individuals develop they choose their own mental environment according to their inherited

[3] "Mendelian Heredity and Racial Differences," *Journ Roy. Anthrop. Inst.*, **55**, 468-482, 1926.

[4] It appears not improbable that the 'death-feigning' instinct of certain insects and other animals has arisen in a similar way through germinal variations in the nervous system.

tastes and aptitudes. In the biographies of great men it often appears that escape from their early environment was their only means of finding self-expression for their inherited mental qualities.

From the point of view I am expressing, mental inheritance is just as real as physical inheritance, and a suitable mental environment is just as necessary for the development of mental characters as a suitable physical environment is for the development of physical characters. Further, the mental environment is extremely complex and intimate in the way it impinges upon the developing individual. One of the remarkable things about organisms, however, is the stability they often show under altered conditions of development, and this appears to be as true of mental as of physical characters. Mental tests apparently show that inherent intelligence, for example, does not develop or grow with the growth of the individual.

Another method by which mental inheritance has been studied is by the comparison of the mentality of identical twins. Galton, the pioneer in this field, cites many remarkable cases of such similarity, in some of which the twins were separated. More recently, many cases have been studied in some of which the separation took place at an early age, making it possible to study the effects of differences in upbringing upon the mental development and the innate abilities. While the mental environment is by no means negligible, and is often profound in its effects on the early development of the mentality, yet it seems clear that innate, *i.e.* inherited, differences persist, which are little if at all affected by the circumstances of life.

There is another matter which, I believe, adds greatly to the complexity of human behaviour. In 1923 I first suggested that when the individual is germinally heterozygous for a pair of contrasted character traits, they may both come into expression in his activities at different times. Indeed, this appears more likely than that there should be complete dominance of a mental character over its allelomorph. I am now looking upon traits of character as different methods of reacting in given circumstances. Since every one is doubtless heterozygous for many such character differences, this would help to account for some of the complexities as well as inconsistencies in human behaviour. Cases of multiple personality are possibly to be explained as more extreme examples of the same kind.

Finally, I should like to reiterate that what is most required now in the study of mental inheritance is an analysis of the mind by psychologists from an inheritance point of view. Psychologists have been so engrossed with the mind as such in its manifold activities that they appear to have neglected the kind of comparative psychology of individuals which is necessary for this purpose.

The Relation between Velocity of Wind and Wave.

By Dr. VAUGHAN CORNISH.

MANY years ago an investigation was begun by me to determine the relative velocity of wind .nd wave in deep water when the former has operated or a sufficient time to produce a constant condition, nd with sufficient sea-room. The results are given in he *Quarterly Journal of the Royal Meteorological Society* or April last, and, at the invitation of the Editor of NATURE, some of the points of interest are brought ogether in this article.

The relation between velocity and period of deep-sea vaves given by the ordinary formula for waves of nfinitesimal height, namely, velocity in statute miles per hour = period in seconds multiplied by 3·493 agrees vith that observed for ocean waves of conspicuous limensions[1] sufficiently for the discussion of phenomena o numerous and irregular.

By timing the rise and fall of spots of spent foam ıpon the water, it is possible to determine from on board ship the period of both the wind-waves and of swell running at the time, whether crossing or concurrent. Employing this method I have never recorded waves with a speed greater than that of the wind, as has been done by other observers, an anomalous result which I attribute to mistaking a heavy swell for the wave when they are concurrent. Observations on a river at turn of tide, when the foam-spots were carried by the current first down-wind and then up-wind, have shown that their wind-drift is small relatively to the other nagnitudes concerned.[2]

[1] See the author in *Jour. Roy. Soc. Arts*, Nov. 1, 1912, " Ocean Waves," and the *Field*, Feb. 13 and 27, 1915, " The Measurement of Waves at Sea."

[2] ... of Wind, Wave and Swell on the North Atlantic Ocean."

In the course of a voyage between Trinidad and Ushant, in very deep water all the time and free from considerable currents on every day but one, the speed of the waves was compared with the average speed maintained by the wind *for one hour or more*, as recorded by a Robinson anemometer fully exposed upon the bridge. When there was no crossing swell to interfere with the development of the waves, their speed was only 1·85 statute miles per hour less than that of wind, which had a sustained average velocity of 20 miles per hour. Thus there was blowing over the wave-crests only a ' light air,' the ' force 1 ' of Beaufort's scale, sufficient to drift the smoke issuing from a chimney but not strong enough to give direction to a wind-vane.

When hove-to in the Bay of Biscay in the storm of December 21, 1911, I determined the speed of the waves as 47·15 miles per hour, when the velocity of the wind, according to the logged Beaufort number, was 52·5 m.p.h. During the exceptionally stormy winter of 1898–99, when I was living within sight of the beach of Bournemouth Bay, the greatest period of a long-sustained series of breakers was 19 seconds, corresponding to a speed in deep water of 66·4 m.p.h. This was recorded on the afternoon of December 29. Gales in the North Atlantic from December 25 to December 29 were logged at 11 and 12 of Beaufort's scale, which correspond to wind velocity of 68 and greater than 75 miles per hour respectively. The greatest wind velocity on land during this winter, as recorded by instruments, was 70-76 miles per hour sustained for one hour.

The breakers above referred to, which were 139 in number and occupied three-quarters of an hour in arrival, were preceded in the morning by five groups

of a few breakers with longer period, corresponding to a deep-water speed of 69·5 m.p.h. The interval between the beginning of the first and the end of the last was 52 minutes, which strongly suggests that they were waves from the squall-struck portions of the stormy sea which outran their neighbours. The time occupied in arrival by the individual groups was from 1 to 2 minutes, which is normal for the duration of a short squall. The figures so far given suggest that the maximum speed of waves is somewhere about $\frac{8}{10}$ths that of the wind as maintained for one hour, and that a squall lasting for a minute or two can speed-up waves which have already been developed. Once when the waves were flattening down in a dying storm in the North Atlantic, I actually saw a travelling squall increase by some feet the height of the few waves subject to its force.

The observations during the fine-weather voyage on which an anemometer was used provide important evidence of the effect of crossing swell in hampering the development of waves by wind. The restriction of height was palpable to the eye. The restriction of speed was measured. With no swell, or with a concurrent swell, as in the Trades, the speed of the wave was only 1·85 m.p.h. less than that of the wind, but with a swell following obliquely the difference was 3·725 m.p.h., and when crossing at right angles or meeting the waves, 7·2 miles per hour.

A result of practical importance to seamen and meteorologists emerged from the observations on days of crossing swell. When this was oblique to the waves the curl, or break, on the water was considerably deflected and therefore ceased to be a trustworthy indication of the direction of the wind.

The following explanation is suggested of the effect of swell to hinder the wave-making action of wind. When there is no swell and the waves have attained considerable steepness a series of travelling eddies is established in the adjacent air with permanent undulations above, and this arrangement nurses the waves. If, however, a swell be also running, the pattern of the inequalities changes all the time, continually deforming the superimposed air, and making its action irregular. If the swell meet the waves, the pattern undergoes rapid change, and the rhythmic action of the wind is greatly hindered; if it follow the waves their pattern changes slowly and the rhythmic action of the wind is less impaired. When the swell cuts squarely across the waves the surface is patterned in cups and cupolas instead of ridges and furrows, which tends to set up air-whirls with vertical instead of horizontal axis, a condition which imposes an additional hindrance to wave-making.

The extent to which swell kept down the waves when crossing obliquely or squarely suggests that the rapid rise of waves on large lakes is not solely due to peculiarities of local winds but is aided by the fact that no residual swell hampers the action of the wind, as usually happens when it comes on to blow at sea. There is one condition at sea, however, when the development of waves is more rapid than in lakes, namely, when it comes on to blow in the direction of the swell already running and with a speed greater than that of the swell. This was the condition which so quickly created the huge regular waves of December 21, 1911, in the Bay of Biscay.

OBSERVATIONS BETWEEN TRINIDAD AND USHANT.

(Speed of wind as maintained for about one hour measured by Robinson anemometer.)

DIFFERENCES OF SPEED BETWEEN WIND AND WAVE, GROUPED ACCORDING TO DIRECTION OF SWELL.

Direction of swell	Character of swell	Date of observation (1914)	Amount by which speed of wind exceeded that of wave	Average difference of speed in statute miles per hour.
Concurrent with waves	High, quick period, slow progression	Feb. 18 ,, 19	1·2 2·5	1·85
	Quick period, slow progression	,, 20 ,, 21	3·9 3·3	3·725
Following the waves obliquely	Slow period, quick progression	,, 28 (P.M.) Mar. 1	3·3 1·4	
One concurrent, one at right angles	That at right angles very slight	Feb. 23	3·1	3·1
One following obliquely, one at right angles	That at right angles very slight	,, 22	0·3	0·3
Swell at right angles, or meeting obliquely	High, with slow period and swift progression	,, 26 ,, 27 ,, 28 (A.M.)	6·0 7·7 7·9	7·2

Mars in 1926.

By Dr. W. H. STEAVENSON.

THE present apparition of Mars is, for observers in the northern hemisphere, the most favourable that has occurred for many years. The planet, which was at opposition on November 4, made its closest approach to the earth on October 27, on which date its distance was approximately 42,600,000 miles and its apparent diameter 20″·4. On August 22, 1924, the distance was 8,000,000 miles less and the apparent diameter so great as 25″·1 (practically the maximum possible), but on this date the planet, at its greatest altitude, was not more than 21° above the horizon of London; whereas, on October 27, 1926, it crossed the meridian at an altitude of 53°. This increase of 32° was more than sufficient to make up for the shrinkage in apparent diameter, with the result that observers in Great Britain have, in general, been able to obtain more satisfactory views than at the closer approach of two years ago. Not until 1941 will there occur an equally favourable combination of altitude and apparent diameter.

In 1926, as in 1924, it is the southern hemisphere of Mars that is presented most favourably for observation, and this always happens at close oppositions of the planet. The Martian season at the time of opposition was not, however, quite the same on each occasion. In 1924 the planet was most favourably placed for observation during the early summer of its southern hemisphere, whereas in 1926 the summer solstice of this hemisphere occurred more than two months before opposition, so that we have a satisfactory seasonal overlap in the observations made in the two years.

The results of this overlap have been very evident

this year in the reduced size of the South Polar cap at the date of opposition, and also in the more advanced development of the usual seasonal changes in the dark markings. These changes, both of colour and intensity, are now firmly established facts, and can be predicted with considerable accuracy. But almost more interesting are those less regular changes of form and intensity which have not yet been found to conform to any definite law. They thus provide an element of variety in our observations of the planet, and, as they are often on quite a large scale, afford opportunities of useful and interesting work to the possessors of moderate-sized telescopes.

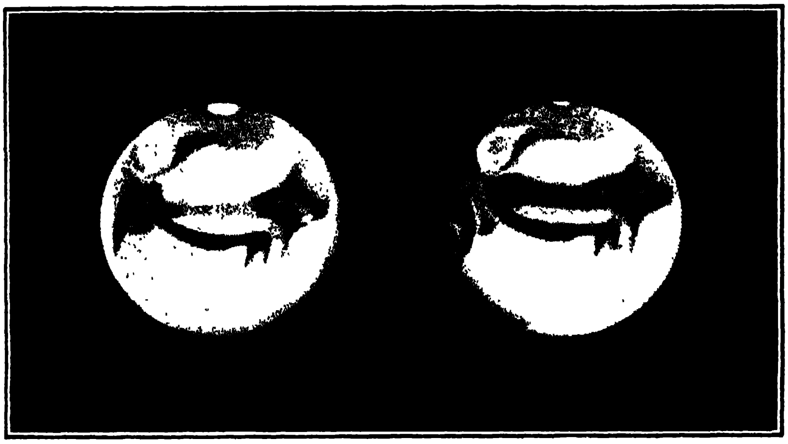

FIG. 1.—Aspects of Mars, September 1924 and October 1926, showing changes in the characters of *Sinus Sabaeus* and *Pandorae Fretum*.

Several changes of this kind have actually occurred since 1924, and some of them have been sufficiently extensive to be visible with quite small instruments. Figs. 1 and 2 show two of the more conspicuous alterations that have so far been noted. Just below the centre of the disc in the two views forming Fig. 1 is a dark belt-like marking. This, the *Sinus Sabaeus*, is nearly always a conspicuous feature; but above it, and separated from it by a lighter strip, is another dark streak, known as *Pandorae Fretum*, which is subject to marked changes from time to time. It will be observed that, whereas in 1924 it was faint and tapered towards the left, it was in 1926 much darker and approximately of the same breadth throughout. So far as the increase in intensity is concerned, the change is partly of a seasonal character, though the darkening took place earlier in 1926 than in 1924. But in the latter year the marking never attained quite the same breadth, so that to this extent the change is anomalous. More striking still has been the change observed in *Solis Lacus*, shown in Fig. 2. This marking, which lies in a region often referred to as the "Eye of Mars," will be readily recognised on both sketches just above the centre of the disc. Irregular changes in the size and outline of the *Lacus* have occurred several times during the past century, but for some years now it has generally appeared roughly pear-shaped, with a thick 'stalk' connecting it with the dark areas on the left. It was of this shape in 1924, as indicated by the first sketch, but since then a complete transformation of its outline has taken place. This, as will be seen, has been brought about by a wide extension of the free end of the 'pear' in a northerly direction, and this extension is much deeper in tone than was any part of the marking in 1924. Further, minor changes in the neighbouring regions will also be noted.

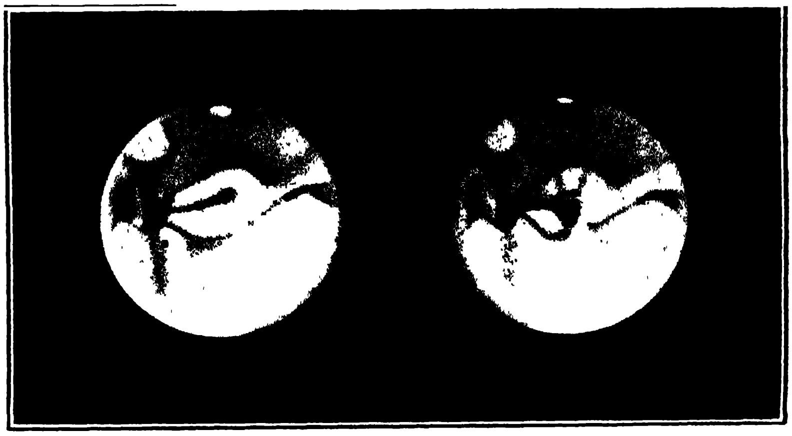

FIG. 2.—Aspects of Mars, October 1924 and October 1926, showing changes in the character of *Solis Lacus*

A satisfactory explanation of such gross changes as these, affecting thousands of square miles of the planet's surface, cannot at present be advanced; but if we assume, as now seems reasonable, that the dark areas of Mars represent tracts of vegetation, it appears possible that the irregular effects observed are due to seasonal abnormalities, such, for example, as the occurrence of unusually wet or dry summers.

There is need, however, for more study before we can reach confident conclusions upon the matter. Fortunately, the observations necessary are not of great delicacy, being in fact well within the range of the instruments commonly at the disposal of amateurs. In the writer's opinion, much valuable time and trouble has been wasted in the past in attempts to observe and delineate the more minute details of the surface of Mars. Such fine detail can at the best be only imperfectly seen in common instruments, and there is room for much difference of opinion as to its precise nature. On the other hand, the extensive modifications of outline and intensity already described are quite beyond all question, and present to us a most interesting problem to which there is good hope of an ultimate solution. Observations made on these lines will increase in value with the lapse of time, and will for many years to come provide profitable work for much smaller instruments than were at one time thought necessary for a successful study of the planet.

News and Views.

LORD BALFOUR presided at the first meeting of the Imperial Conference Research Sub-Committee held on October 25. In his opening speech he re-emphasised the points made in Mr. Amery's address to the Empire delegates the previous week. Research is more important to the British Empire than to any other great power. The Empire in its different parts is confronted with a bewildering variety of problems of almost baffling complexity, the solution of which depends upon the success of the efforts of a considerable body of research workers and the effective co-ordination of their work. Reference was made to the co-ordinating machinery already developed, in which the Department of Scientific and Industrial Research, the Development Commission, the Medical Research Council, and the Royal Society participate. Much of the work undertaken by those bodies is of interest to the Dominions and Colonies, but it is an open question whether the existing machinery is adequate to the needs of the tropical countries of the Empire with their special needs and problems. Representatives of the Dominions followed Lord Balfour with accounts of the efforts being made in their respective countries to apply science to the solution of their particular problems, the representatives of Australia and New Zealand paying warm tributes to the assistance they had received from Sir Frank Heath during his recent visit. Mr. D. T. Chadwick said that the devolution of larger powers to the Provinces in India had been a serious obstacle to the effective co-ordination of research. Mr. Ormsby-Gore, who wound up the discussion, spoke of the isolation of the research workers in tropical colonies of Great Britain, their difficulties of inter-communication, and their dependence on the prosecution of research in the Dominions and Great Britain, and the more effective distribution of the results obtained. There is a scarcity of scientific investigators in the tropics, to remedy which he urged the provision of more highly paid posts such as would induce promising scientific workers to enter the Colonial Service.

AT the third meeting of this committee Mr. J. W. Dulany gave an account of the progress of research work in the Irish Free State. He was followed by Sir William Clark, Comptroller-General of the Department of Overseas Trade, and Dr. A. W. Hill, who described respectively the functions of the Imperial Institute and the Royal Botanic Gardens, Kew, in connexion with Empire research. The reference made to the potentialities of the Imperial Institute as a co-ordinating centre for imperial activities in scientific research is welcome in view of the sceptical attitude of some of the Dominion representatives regarding its work and functions expressed at the meeting of the Imperial Conference held in 1923. The Institute has been persistently starved for funds, the contributions of the Dominions and the Tropical Colonies having been niggardly in the extreme; its scientific staff has met with every kind of discouragement for years, having been inadequately paid, given no security of tenure, and forced to work with inadequate laboratory accommodation and equipment; and much of the work for which it was originally intended has been handed over to other bodies, *e.g.* the Imperial Entomological Bureau and the Imperial Mineral Resources Bureau. Nevertheless, it has a nucleus staff, the members of which have striven for years in the face of these various difficulties to investigate the problems in connexion with the utilisation of the plant and mineral resources of the Empire and to act as a clearing-house for Imperial researches. Properly endowed it could become a very important factor in the co-ordination of Empire research, and it is to be hoped that the awakening of the Dominions to the importance and meaning of scientific research means that they will be prepared to give this institution the support it deserves.

THE speech on Empire air transport by Sir Samuel Hoare, Secretary of State for Air, at the Imperial Conference on October 28, may be taken as giving the collective views of his engineering staff. It would be interesting to have individual opinions, and to compare their sum with their resultant. With regard to fighting forces, the need for aircraft is a *chose jugée*; every belligerent will acquire the most numerous and effective aircraft it can get, from its own or neutral industry, for scouting, bombing, and fighting. Civil air transport has been proved over so wide a range of conditions that its extension to an Empire network is practically a question of finance. Airship service in war seems to be ruled out by the restriction that an airship must never come within range of an aerodrome or an aeroplane carrier. With regard to civil transport by airship, the record of service is adverse to the hope that even lavish expenditure will maintain regular services over Empire routes, and a schedule of 2½ days to Canada, 5 days to India, 6 days to Cape Town, 11 days to Australia, and 13 days to New Zealand, seems to outrun present knowledge. The technical staff concerned is working hard to reduce the difficulties inherent in the design of these vast structures, lighter than the turbulent atmosphere which sustains and buffets them, but the increase of size and change of form, by which it is hoped to solve some of the problems, demands extrapolation far beyond previous experience.

FOLLOWING the address of the Secretary of State for Air to the Imperial Conference, interesting accounts were given by the Dominion premiers and the Under-Secretary of State for India of the development of the air services for which they are responsible. The progress which has been made since the last Imperial Conference appears to be most gratifying and opens up romantic possibilities. It was evident that these appealed strongly to Mr. Amery, who summed up the discussion. He drew a picture of the isolated white worker in the tropics making business calls in his own aeroplane and flying to a bungalow in the nearest hills for a week-end rest. He remarked

on the potentialities of the aeroplane in connexion with forest, fishery, and geographical surveys. The use of aeroplanes for the extermination of insect pests in the American cotton plantations area opened up the possibility of its extended use to the extermination of the tsetse fly in Africa. He struck a welcome note when he mentioned the discoveries which have been made from the air of long-forgotten cities, an old sacrificial way to Stonehenge, and archæological treasures in Sind, remarking that the use of the aeroplane in archæological research, one of the least material of researches, is not unworthy of the notice of the British Empire.

THE first department of anthropology in Australia has just been established in the University of Sydney. Funds for this purpose have been provided by the Commonwealth Government and the Governments of the various Australian States. Prof. A. R. Radcliffe-Brown, for some years past professor of social anthropology in the University of Cape Town, has been appointed to the new chair and took up his duties at the beginning of July. Provision has been made for including anthropology as a subject for the B.A. and M.A. degrees, and it is also proposed to offer a diploma in anthroplogy similar to that offered at Cambridge. Plans are being made for a special course of training in anthropology to be given at Sydney to cadets entering the Administration of the Mandated Territory of New Guinea. Special courses are also being provided for officials in New Guinea and Papua, missionaries and missionary students, and others who are unable to attend the University for a year and therefore cannot .e the full diploma course. The Rockefeller Foundation has placed at the disposal of the Australian National Research Council a sum of money for anthropological research in Australasia. The funds to be released in any one year are to be determined by the amount contributed for anthropological studies from other sources with a limit of 20,000 dollars a year. The Australian National Research Council has appointed a committee on anthropological research to advise on the expenditure of these funds, and plans are now in active preparation for carrying out researches in physical anthropology and ethnology.

THE report on the excavations at Lubaantun, British Honduras, on behalf of the British Museum, recently presented to the Trustees, of which a summary appeared in the *Times* of October 28, makes interesting reading. It is more than likely that this site will prove one of the most important in Central America in its bearing on the obscure question of the origin and early history of Maya culture Not only is the site the largest, but it is also probably the earliest of Maya centres. Its extent, and the number and size of its buildings, including the hillside terraces which aroused so much interest when first reported, demand a very high antiquity for the period of its inception. The work must have been continued over a very long time as well as required the efforts of a numerous and highly organised population. Further, the pottery and the plaques and figurines from surface finds correspond with the artistic style of "Early Maya" on such early sites as Copan and Quirigua, obviously a product of a long period of development, so that when the lower strata at Lubaantun are excavated, discoveries illuminating for the early history of the Maya may be expected. In many respects the Lubaantun site has proved to be unique in Maya culture. Of the four styles of architecture found on the site, one style of building which employed huge blocks of stone, large enough almost to justify the title 'megalithic,' was not hitherto known in Central America, though it occurs in Peru; while a so-called 'in-and-out' style is new in American architecture.

SENATOR MARCONI gave a very interesting James Forrest lecture to the Institution of Civil Engineers on October 26, when he discussed radio communication, with special reference to waves of short wave-length—that is, to high-frequency waves. It is common knowledge that the ether is becoming very congested with radio waves of certain frequencies. It is necessary, therefore, in order to utilise radio communication to the utmost, to extend the range of commercial frequencies. It was first pointed out that many uses can be made of radio waves, particularly in controlling mechanisms such as targets, torpedoes, and aeroplanes at a distance. It is probable also that electric power will soon be transmitted through the ether over moderate distances. The difficulty that has to be overcome is to project the waves in a parallel beam so as to minimise the dispersion and diffusion of the energy into space. A few years ago, radio engineers were much more confident about their formulæ than they are to-day. Applying them logically, they found it necessary to use very large amounts of power and enormous and expensive aerial systems to ensure communication to great distances. Consequently the high working costs prevented any substantial reduction in telegraph rates. Senator Marconi said that the whole theory and practice of the art is being revolutionised. Until quite recently long-distance transmission was carried on exclusively by employing wave-lengths lying between 8000 and 30,000 metres (37·5 to 10 kilocycles per sec.) The Post Office Station at Rugby, for example, uses waves having frequencies of 16 kilocycles per sec. The total power used at this station is 1400 kilowatts. Many similar stations are operating in other parts of the world, their cost being of the order of 500,000*l*.

FOR the last ten years Senator Marconi, with the help of Mr. C. S. Franklin, has been experimenting with high-frequency waves. In 1923 and 1924 very satisfactory results with waves having 3260 kilocycles per sec. were obtained. It was found that the daylight range steadily increased as the frequency of the waves was increased, the absorption decreasing very rapidly the higher the frequency was made. These results, Marconi said, cannot be explained merely by refraction, as the signals received over world distances are thousands of times stronger than indicated by the refractive theory. The Australian tests showed that with 9370 kilocycles per sec. it was possible to communicate for more than 23 hours out of the 24. With these high-frequency

waves the dimensions of the aerials and reflectors are reduced proportionately and very little power is required. The Marconi Company has been given the contract to make high-frequency stations for Imperial communications. At the Bodmin station for communicating with Canada, thermionic valves generate the necessary high-frequency currents of 11,500 kilocycles per sec. Communication with Canada at the rate of 2500 letters per minute over the whole circuit has been maintained for hours at a time. With these waves 'atmospherics' interfere very little. Even thunderstorms in the vicinity of the receiving station only cause interference when they are inside the angle of the receiving reflector. The high-power low-frequency stations in Great Britain are receiving and transmitting to America at an average speed of twenty words per minute for 18 hours a day. The low-power high-frequency stations, however, can work at least five times as fast over the same distance and for the same time. We are yet a very long way from being able to utilise radio waves to anything like their full extent. Their range of usefulness can be very greatly extended, and this will occupy the attention of engineers for many years to come.

A VALUABLE survey of the development and present position of the chemistry of the proteins was afforded on October 28 to fellows of the Chemical Society, when Prof. S. P. L. Sorenson, of Copenhagen, delivered the Hugo Müller lecture. The work of Mulder, of Proust and Braconnot, of Liebig, of Cramer, and of Hopkins and Cole on the composition of protein substances was mentioned, Emil Fischer's view that they consist essentially of amino-acids united by -CO · NH- linkings for many years formed the general foundation of all such researches, but recent work invites a modification of that conception. Prof. Sorenson is of opinion that conclusive evidence in favour of Troensegaard's pyrrole-ring structure is lacking, although it is clear that linkings other than those of the simple peptide type are present. It is, in fact, highly probable that some part of the nitrogen is present in heterocyclic structures, probably diketopiperazine rings. The observation, however, that none of the usual proteolytic enzymes attack diketopiperazine, whilst polypeptides are readily decomposed by erepsin, supports Abderhalden's contention that the diketopiperazine section of the protein molecule probably exists in a labile, tautomeric form, a consideration which the lecturer discussed in some detail. Further, he said, it is absolutely necessary to submit to closer examination the question as to how compounds having the assumed structure will behave towards proteolytic enzymes before attempting to reach decisive conclusions regarding the constitution of protein substances. Such investigations are being carried on by Waldschmidt-Leitz and his collaborators.

PROF. SORENSEN turned next to the problem of the characterisation of individual proteins, in which small differences in the elementary composition are of relatively great importance. So, also, it is essential to distinguish between integral constituents and adherent or loosely-bound substances. Linderstrøm-Lang has succeeded in obtaining casein fractions containing different amounts of phosphorus, naturally raising the question whether it is possible to prepare casein free from phosphorus, yet still able to give the rennin reaction. In egg-albumin the phosphorus content is practically constant, and that element appears to be intimately associated with the rest of the molecular complex; but only a small part of the coagulable phosphorus of the serum-proteins is precipitable by alcohol. Hence it appears that the phosphorus is but loosely associated with the serum-protein complexes. Purification of the two proteins concerned by precipitation with alcohol at -4° gives results entirely in harmony with this conclusion. Prof. Sorensen's estimate of the molecular weight of the egg-albumin molecule is 34,000, corresponding with about 380 nitrogen atoms. By the application of electro-analysis to egg-albumin solutions, it is possible to reduce the phosphorus content to a value not far removed from that required if one phosphorus atom is present in such a molecule. Similar results have been obtained by long-continued storage in ice.

THE Zentralanstalt for meteorology and geodynamics at Vienna was founded in 1851, at the instance of the Vienna Academy of Sciences; the seventy-fifth anniversary of the Institute therefore falls this year, and at the suggestion of the Director, Dr. F. M. Exner, the Academy has celebrated the event by issuing a *Festschrift* dedicated to the Institute. The volume, of about 200 pages, contains 13 papers by Austrian and German geophysicists, among the authors being Ficker, Exner, W. Schmidt, A. Wegener, Defant, Conrad, and A. Wagner. Wegener describes observations of twilight bows and zodiacal light made in Greenland in connexion with J. P. Koch's expedition of 1912-13, the last twilight bow appeared to be produced by the atmosphere at a height of not less than 700 km., an elevation unparalleled among atmospheric phenomena except by the aurora. The other papers, too numerous to summarise, are mainly meteorological, but there is one relating to variations of seismic activity in regions of folding, and another on the influence of the earth's rotation on the course of rivers.

THERE are now two international organisations which deal with meteorology: the International Union of Geodesy and Geophysics and the International Conference of Directors. By mutual arrangement, the former concerns itself only with the scientific side of meteorology, while the practical application is left entirely to the latter. The Conferences of Directors are held every six years, and at each a number of Commissions is appointed to deal with various aspects of practical meteorology, membership of which is not limited to members of meteorological services. Eight such Commissions met in Zurich on September 13-20. The British representatives were: Dr. G. C. Simpson, president of the Commission for the Réseau Mondial; Lieut.-Colonel E. Gold, president of the Commission for Synoptic Weather Information; Dr. C. Chree, president of the Commission for Terrestrial Magnetism and Atmospheric Electricity; Sir Gilbert Walker;

Sir Frederic Stupart (Toronto); Mr. C. J. P. Cave; Mr. C. Stewart (Pretoria); and Mr. R. A. Fisher. Afterwards the International Meteorological Committee met in Vienna on September 23-28 under the presidency of Prof. van Everdingen (Holland). The following are amongst the chief decisions reached: A system of visual gale warning signals, for day and night, was adopted for all national services, and agreement was reached as to the conversion of velocities read on anemometers into Beaufort Numbers for weather telegrams. The International Cloud Atlas—prepared in 1895 by Messrs. Hildebrandsson, Riggenbach, and Teisserenc de Bort—has for some time been out of print; a new atlas is to be prepared which will contain a new set of photographs and the proposed changes, for the consideration of the Conference of Directors meeting in 1929. An anonymous donor has generously provided funds for the purpose. Throughout its history the International Meteorological Committee has had no permanent staff and no funds. All secretarial work and the publication of the reports of the meetings have been undertaken by one or more of the national meteorological offices. It has now been decided that the time has come to establish a secretariat to look after the records of the Conference, Committees, and Commissions, to arrange the meetings, and to publish the records.

SCIENCE Service, the endowed organisation that supplies scientific news to ephemeral publications in the United States, has made a new departure by issuing its "Weekly News-Letter" in printed form to individual purchasers. The copy before us contains sixteen pages ($10\frac{3}{4}$ in. × $8\frac{3}{4}$ in.), more than six of which are occupied by matter relating to the Service and by 'fillers,' the arrangement being such that any article can be cut out without damaging any other. To facilitate the indexing of cuttings, each article bears a key-word above the title and a date at the end. The price is the very moderate one of 5 dollars per annum, or 10 cents per copy, but teachers, professors, librarians, and club-leaders may obtain each issue for 6 cents. The idea of penetrating the class-room is good, and the matter should be useful for enlivening the teaching of science and geography. In style, the articles and notes are crisp and restrained, and although in some articles the language could have been simplified, as a whole they are better written than the scientific news items that occasionally appear in our daily press. They are, however, somewhat marred by the headings, which betray the inaccuracy born of sensationalism and the love of alliteration. Thus, the title "Ice Cream from Crude Oil" is chosen for a description of recent work on the use of certain petroleum constituents as raw material for making edible fats and other natural products; and an article entitled "Fighting Forest Fires with Weather Service" contains nothing about combating fires, but is an interesting account of work undertaken by the U.S. Weather Bureau in forecasting atmospheric conditions that favour the occurrence and propagation of forest fires (which are stated to do 16 million dollars' worth of damage every year). In a country like Germany, and to a less extent the United States, a publication of this kind should find a good market; in Great Britain, where scarcely a single scientific periodical is to be seen on a railway bookstall, or in a bookseller's shop, its chance of success would be very small.

THE opening meeting of the Illuminating Engineering Society on October 26 was, as usual, devoted to reports of progress and exhibits of novelties in lamps and lighting appliances, photometric instruments, etc. The summary of progress during the vacation presented by Mr. L. Gaster contained several interesting items of news, such as the references to the inclusion of provisions requiring sufficient and suitable lighting in the new Factory Bill now before Parliament, and to the formation of an Illuminating Engineering Society in Holland. The address also summarised experiences during Mr. Gaster's recent visit to the Continent, where illuminating engineering is being keenly studied. In view of the widespread propaganda on lighting and the efforts being made in all countries to develop the commercial exploitation of illuminating engineering, the need for the maintenance of a scientific and impartial attitude on the part of the illuminating engineering societies in the various countries was strongly emphasised. Another lengthy report, read by Mr. J. Y. Fletcher, surveyed progress in electric lighting during the past year. Afterwards there were a number of interesting exhibits. Developments in lighting on the railways were dealt with by Mr. S. G. Elliot (Underground Railways), and Mr. A. Cunningham (Southern Railway). A new form of daylight-factor meter was shown by Mr. H. Buckley of the National Physical Laboratory, Teddington, and the latest model of the Holophane Lumeter photometer by Mr. H. Allpress. Other exhibits included the new Sheringham reflector yielding a light visually resembling daylight in colour, the internally frosted electric incandescent lamps, and some pleasing forms of decorative lighting units of the enclosed type.

WITH the control over epidemic diseases which has been obtained in recent years, and with the increasing proportion of elderly persons in the population, cancer has come to be one of the most important killing diseases. On September 20 and the following days, an international conference, organised by the American Society for the Control of Cancer, was held at Lake Mohonk, New York State, and was attended by representatives from most European countries. The various papers and discussions brought out nothing of a very novel character, but they made clear the steady advance which is being achieved in diagnosis and treatment, and in an understanding of what cancer is. The results were issued to the public in the form of an agreed statement which should be helpful. The conference says that cancer (1) is not contagious or infectious, (2) is not hereditary, and (3) can, so far as is at present known, be controlled only by attention to personal hygiene and by early diagnosis and treatment. The interest and co-operation of the lay public have done much to

improve general healthiness; we may hope that equally good results will follow in dealing with cancer.

DR. RUDOLF ABEL, professor of hygiene, University of Jena, delivered two lectures under the Chadwick Trust on October 19 and 20, taking as his subject "The Development and Present State of Public Health in Germany." The lecturer first described the bad hygienic conditions formerly prevailing in Germany. It was only after the foundation of the German Empire in 1871 that practical care of health was developed, and the conversion of Germany from a mainly agrarian State into an industrial one, with the development of the towns that followed this change, took place without disaster, thanks to the improvements in sanitary conditions which had likewise been proceeding. Public Health administration and legislation were then discussed. The Medical Officer of Health in Germany is a State official paid by the State, but the cost of hygienic institutions and sanitary work is borne by the community. During the last fifty years the death rate has diminished more in Germany than in England, so that now the two countries are nearly on a level. As regards infectious diseases in Germany, notification of and inquiry into the cases, isolation and disinfection, are very similar to those obtaining in England. The campaign against tuberculosis is carried on by means of dispensaries, visits to the family, sanatoria and hospitals, and by education of the people on a large scale. Venereal disease increased much during the War, but is being dealt with by free consultations and treatment. Alcoholism diminished during the War owing to shortage of alcoholic beverages, but has since shown a recrudescence and is being combated by licensing regulations, clinics, and temperance societies. Maternal and child welfare is being cared for by special legislation, and infant mortality is declining, though it is still higher than in England. Industrial hygiene has been regulated in detail by many legal enactments. Housing conditions are not good in German towns; there is much over-crowding and a great shortage of accommodation. Very much is also being done for the social welfare of the poorer classes.

PROF. W. J. HUSSEY, Associate of the Royal Astronomical Society, Director of Detroit Observatory, Ann Arbor, U.S.A., died very suddenly on Thursday last, October 28, in London, at sixty-four years of age. He had arrived from America a few days before, and was to have sailed the next day for South Africa, where he was to have set up a 27-inch telescope on a site to be chosen—probably Bloemfontein.

THE Norman Lockyer Lecture of the British Science Guild will be given in the Goldsmiths' Hall (by kind permission of the Goldsmiths' Company) on Tuesday, November 23, at 4 P.M., by Prof. J. S. Huxley, who will take as his subject "Biology and Human Life." Tickets for the lecture may be obtained on application to the Secretary, British Science Guild, 6 John Street, Adelphi, London, W.C.2.

AT the annual statutory meeting of the Royal Society of Edinburgh held on October 25 the following officers and new members of council were elected: *President*, Sir James Alfred Ewing; *Vice-Presidents*, Dr. W. B. Blaikie, Sir Robert Blyth Greig, Prof. T. H. Bryce, Prof. E. T. Whittaker, Dr. James Currie, Dr. A. Crichton Mitchell; *General Secretary*, Prof. R. A. Sampson; *Secretaries to Ordinary Meetings*, Dr. A. Lauder, Prof. W. Wright Smith; *Treasurer*, Dr. J. Watt; *Curator of Library and Museum*, Prof. D'Arcy W. Thompson; *New Members of Council*, Mr. J. W. Peck, Dr. J. Ritchie, Prof. R. Stanfield, Dr. A. L. Turner, Dr. G. W. Tyrrell.

THE sum of 400*l*. is allocated in each calendar year by the Institution of Petroleum Technologists to the advancement of research in petroleum technology and its basic sciences, and the Council is prepared to receive applications for assistance from this fund. Applicants proposing to engage in research in a university institution must be recommended by the professor under whom they propose to work. Applications from full members of the Institution require no additional support. Applications for grants from this fund must be received by the Secretary not later than December 1. Application forms may be obtained from the Secretary of the Institution at Aldine House, Bedford Street, Strand, London, W.C.2.

MESSRS. Automatic and Electric Furnaces, Limited, 173-175 Farringdon Road, London, E.C.1, inform us that they have a complete series of lantern slides, illustrating electric furnaces for hardening, tempering, carburising, annealing ferrous and non-ferrous metals, glass, etc., together with component parts of such furnaces, automatic temperature controls, and wiring diagrams, connected with various forms of circuits. These slides are available for the use of engineering societies and other technical associations.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant lecturer on electrical engineering at the Government Technical Institute, Insein, Burma—The Secretary to the High Commissioner for India, 42 Grosvenor Gardens, S.W.1 (November 15). A Physicist to the Radio-Therapeutic Department of the Cancer Hospital—The Secretary, Cancer Hospital, Fulham Road, S.W.3 (November 20). A mistress of mathematics and science in the training department of the Dow Hill Girls' School, Kurseong, Bengal—The Secretary to the High Commissioner for India, 42 Grosvenor Gardens, S.W.1 (November 27). A lecturer in physics in the Queen's University of Belfast—The Secretary (December 4). A junior technical officer at an Admiralty Experimental Establishment, with good practical knowledge of the design, manufacture and testing of wireless telegraph apparatus, and small alternating and direct current appliances—The Secretary of the Admiralty (C.E. Branch), Whitehall, S.W.1. An assistant chemist under the Empire Cotton Growing Corporation for soil investigations in the Sudan—Dr. E. M. Crowther, Rothamsted Experimental Station, Harpenden.

Research Items.

THE RAINMAKER AMONG THE LOTUKO, S. SUDAN.—In *Sudan Notes and Records*, Vol. 8, No. 2, Prof. C. G. and Mrs. Seligman have published notes on material relating to social organisation collected among the Lotuko of the Southern Sudan in the winter of 1921–1922. The Lotuko are organised into a number of independent territorial groups, each including a number of villages and divided into clans. At its head is a rainmaker (*Kobu*, fem. *nobu*), who is commonly referred to as "Sultan" by any Arabic-speaking Lotuko. He is the religious as well as the temporal head of the community. Both parents of a rainmaker should "have rain," though individuals with rain descent on the male side only have attempted to set up as rainmakers. They are not confined to any particular clan, but vary in different localities. Yet the clan gains prestige from his membership and his seat is looked upon as the headquarters of the clan. This tends to a territorial grouping of clans. A male rainmaker succeeds to the office on the death of his father, but a female cannot perform rain ceremonies until she is married to a rainmaker. A pool, Itaraba, has a sacred character and is associated with a semi-mythical rainmaker who is said to have lived five generations ago. In this pool live the crocodiles who are the deceased rainmakers of the Igago clan. A gourd of its water plays an important part in the rainmaking ceremony.

GYPSY MARRIAGE IN ENGLAND.—Mr. T. W. Thompson, who has been engaged in investigating gypsy marriage customs for some years, publishes in the *Journal of the Gypsy Lore Society*, Series 3, Vol. 5, Pt 1, the results of a detailed analysis of a number of records of marriages contracted in some of the leading gypsy families in the nineteenth century. From these it is deduced that descent in the direct line and common parentage are bars to matrimony, notwithstanding a case of marriage to a grand-daughter, and one of a half-brother and sister. There has been a number of cases of marriage between uncle and niece, and aunt and nephew, the latter less frequently, and usually uncles have preferred their brothers' to their sisters' daughters The mating of first cousins has been exceedingly common in some families, and first cousins marry more frequently than second cousins. There is also a marked preponderance of ortho-cousin over cross-cousin marriages, which reflects a definite tendency towards marriage within the family circle. On the other hand, certain southern groups seem to show a preference for cross-cousin marriage, and generally with daughters of a mother's brother rather than a father's sister. It is suggested hypothetically that the Indian proto-gypsies possibly practised a two-clan exogamy, such as actually exists among Indian nomads classed as 'gypsies,' and that on quitting India they had a marked tendency to wed near kindred. Further, that while sojourning on the upland stretches between India and Armenia under the influence of Iranians and Arabs, they weakened the hold of exogamy and strengthened the tendency to alliances between close blood relatives. Polygyny occurs sporadically and the marriage of two or more brothers to two or more sisters is specially common. Further, a polygynist's wives have more often than not been sisters. Formerly it may have been usual to wed a deceased wife's sister and for a young widow to wed a brother-in-law, also it may not have been permissible to wed a younger sister before an elder In addition to the sororate and the levirate there is evidence for the custom which exists among the Santals of India by which a man might cohabit with his wife's sisters before their marriage.

THE INSECT FAUNA OF THE DUTCH EAST INDIES.—Two recent supplements to *Treubia*, the official zoological journal of the scientific institutes at Buitenzorg, are of special interest to entomologists. The supplement to vol. 6 (April 1926) is devoted to an extensive monograph of the Tabanid flies of the Dutch East Indies by Dr. J. H. Schuurmans Stekhoven, jr. This work forms a bulky volume of 552 pages with 18 excellent three-colour process plates of representative species. The fact that certain Tabanids play a significant part in the transmission of the disease known as 'surra' has evidently prompted the large amount of study and collecting that has been entailed in the production of this important monograph. It is probable that *Tabanus striatus* is the most prevalent mechanical transmitter of that disease in the East Indies, but it is very uncertain whether or not other species and genera of these blood-sucking flies may also be implicated Altogether 266 species of the family are fully described in this work, and many are new to science. The supplement to vol. 8 (July 1926) consists of a very detailed study of the immature stages of Malayan Thysanoptera by Mr. H. Priesner. This work forms, unquestionably, one of the most careful and accurate accounts of the post-embryonic forms of those insects that has so far appeared anywhere. The abundance of material at his disposal has enabled the author to construct family, generic, and specific keys to the identification of both primary and secondary larvæ, while his descriptions are greatly enhanced in utility by the 16 plates illustrating numerous structural features.

THE RESPIRATORY EXCHANGE OF THE MUSSEL.—In a very interesting paper in the *Biochemical Journal* (vol. 20, No. 4, 1926, p 289) Mr. J R. Bruce describes an apparatus by means of which he studied the gaseous metabolism of a stock of common mussels, *Mytilus edulis*, L., kept in a large concrete tank at the Marine Biological Station, Port Erin. For the experiments, equal samples were taken from the stock at fifteen roughly equal periods between March 1925 and April 1926; oxygen was determined by Winkler's method and carbon dioxide by an indicator method elaborated by the author It was found that the oxygen requirements rose and fell in close agreement with the rise and fall of the temperature during the year, and also, though to a slighter extent, depended on the oxygen pressure. By making corrections for variations in these two factors, a third variation in oxygen intake was made evident which followed closely the reproductive cycle, there being an increase of 30 per cent. per unit weight of wet tissue between July and March, the period in which the reproductive reserves (largely glycogen) are being built up after the depletion consequent on the spawning of the previous spring. A point of the greatest interest is furnished by the disparity between the respiratory quotients at different periods, it being at its lowest in June and July and rising to a maximum in March. This is apparently associated with the changing chemical composition of the tissues during the period when glycogen is being stored, the drop from March to May corresponding to the period of fat formation preliminary to spawning in May.

THE MECHANISM OF GEOTROPIC CURVATURE.—We are still 'in the dark' as to the mechanism which is responsible for the different geotropic curvatures manifested by shoot and root, and recently another

suggestion has come from Polish sources. F. Tondera directs attention to the early work of Kraus, who showed that the amount of water in the tissues on the upper and lower side of a horizontal axis may be different, and suggests that the gravitational influence on sap distribution will be different upon the cortex of a root, from which water is moving inwards to the stele, and the cortex of the shoot, which is evaporating water and receiving a fresh supply moving outwards from the stele. He concludes that as a result the gravitational effect upon a horizontal root may reinforce and increase the natural sap movement on the upper side of the root and the lower side of the shoot, thus causing downward (positive) geotropic curvature in the first case and upward (negative) curvature in the second. His paper in the *Bulletin International de l'Académie polonaise des Sciences et des Lettres*, 8 B, 1925, contains very little experimental evidence; but the theory recalls in some respects the suggestion recently put forward by Ricôme in the *Rev. Gén. de Botanique*.

THE ROCKS OF JAN MAYEN.—The first comprehensive collection of rocks from the hitherto little known island of Jan Mayen was made by Mr. J. M. Wordie in 1921. This material has now been studied petrographically by Dr. G. W. Tyrrell, and the results, together with seven new analyses, are recorded in the *Trans. Roy. Soc. Edin.* (vol. 54, Pt. 3, No. 10, Oct. 2, 1926). The most abundant rocks appear to be trachybasalts with subsidiary trachytes and ankaramite (ultrabasic olivine basalt) and they occur as lava-flows or small intrusions. Trachyandesites and plateau-basalts are also known, but so far only as blocks and pebbles in a volcanic conglomerate. The only previous analysis of first-class importance was made by Dr. H. F. Harwood of a trachybasalt described by Prof. A. Holmes in 1918. The new analyses now recorded show that the suite as a whole is of mildly alkalic character with titanium dioxide ranging up to nearly four per cent. Holmes's deduction of a richly titaniferous belt in the Brito-Arctic Province stretching from Greenland to the Hebrides thus receives further support. The original magma appears to have been of trachybasaltic composition, differentiation having produced sub-magmas of trachytic and ultrabasic extremes. The specimens of plateau-basalt seem to be more ancient than the exposed lavas and they probably represent the underlying basement of the island.

SPANISH PETROLOGY.—The Iberian Peninsula consists structurally of three main tectonic features: a central plateau of pre-Cambrian and Palæozoic rocks which were extensively invaded by granites towards the close of the Carboniferous; a southern Betic Cordillera of folded rocks, and a similar northern folded belt forming the Pyrenees and Cantabrian Mountains. Hitherto little has been known of the chemical characters of the Carboniferous granites, but in a recent paper this deficiency is made good by Dr. H. S. Washington (*Journ. Wash. Acad. Sci.*, Sept. 19, 1926). All the specimens studied, of which four have been analysed, are simple biotite granites of approximately average composition, the uniformity in this respect being especially noteworthy. The later igneous rocks of the folded and faulted borders are strikingly different, as they include a wide variety of alkaline, mostly soda-rich, types. It is pointed out in a comparative survey that a similar contrast between granitic horsts and alkaline peripheral regions is shown by many other areas, such as the Canadian, Brazilian, and Fenno-Scandian shields. The distribution of soda rocks around older granites is regarded as unfavourable to the hypothesis that they are derived from basaltic magmas by assimilation of limestones.

WEATHER IN SAMOA.—The report of meteorological observations for 1923 made at the Apia Observatory has recently been received. Magnetic, meteorologic, and seismic observations are given in detail. Magnetic disturbances were not numerous during the year, and those which occurred had little effect upon the declination. The mean air temperature for 1923 was 26°·08 C., while the normal for the years 1890–1923 is 25°·78 C. The total rainfall in 1923 was 3772·6 mm. and the normal is 2688 mm. The abnormal rainfall was largely due to the unusual precipitation during March, when rain was general throughout the Samoan Islands; at Alsisa the fall for the month was 117·82 in. (2993 mm.) This unusually heavy precipitation was the result of a circular storm which originated to the south-west of Samoa and was considered by residents to have been the most severe in twenty-five years. It caused general damage to roads and public works and resulted in considerable reduction of the copra output for the year. Of 119 earthquakes 79 were local and had their epicentre within 100 km. of the observatory; six earthquakes were reported as felt by people living in Apia and vicinity. Between June 1 and December 31 eighty-one balloons were sent up, and thirty nine of these were followed to a height of 5 kilometres or more. The greatest altitude observed was 21 kilometres, on December 19. Grateful acknowledgment is expressed of substantial grants from the Carnegie Institution of Washington and from the British Admiralty.

INVAR STEEL BALANCE BEAMS.—The issue of the *Proceedings of the Physical Society of London* for August 15 contains a paper by Mr. J. J. Manley on the properties of a precision balance with beams of invar steel, which was shown by Messrs. Oertling at the Exhibition of Apparatus held by the Physical and Optical Societies in January last. The great rigidity of the beam reduces the bending under load and gives a sensitivity independent of the load. The small coefficient of expansion of invar was not found to make the resting point of the beam independent of temperature, and Mr. Manley attributes this to relative movements of the knife edges themselves. The magnetic field has its effect on the beam, but any error due to this may be eliminated by using Gauss's method of double weighing. In the discussion of the paper, Mr. Gould stated that the effect of temperature changes on the invar steel balance of the National Physical Laboratory was of the same order of magnitude as that found for balances with gun-metal beams as usually made.

THEORY OF AIRSCREWS.—Recent developments in vortex theory in its application to airscrews has enabled the behaviour of a propeller under normal working conditions to be examined, but the theory breaks down in the vortex ring state and in part of the windmill brake state. Some recent empirical extensions of the theory based on general theoretical arguments have provided some information regarding the general nature of the characteristic curve. These are embodied in a report by H. Glauert (Aeronautical Research Committee, R. and M. No. 1026, H.M. Stationery Office, 3*d.* net). The experimental data are analysed to determine the form of the characteristic curve for those regions for which the vortex theory is inapplicable or inaccurate. An empirical form of the characteristic curve has been determined fitting the experimental data and connecting up with the theoretical curves in the propeller and windmill brake

state, but its precise form will remain somewhat uncertain until further experiments are available from an open jet tunnel. Further developments along these lines are clearly indicated in the near future.

SUPRACONDUCTIVITY. — W. Meissner, *Zeit. für Physik*, vol. 38, p. 647, 1926, has recently examined the low-temperature resistance of single crystals of cadmium, gold, and zinc, and of very pure specimens of iron, nickel, platinum, and silver in the form of wires. Although measurements were made at temperatures so low as 1·3° absolute, no indication of the phenomenon of supraconductivity was found with any of these metals. It thus appears that supraconductivity may only be exhibited by a particular group of metals, although it is still possible that at temperatures lower than 1·3° absolute the above metals may exhibit it.

THE MOLECULAR WEIGHTS OF THE PROTEINS.—Analytical and physical-chemical methods indicate that the proteins have very large molecular weights; *e.g.* the smallest, of egg albumin, is approximately 34,000. Recent work on the lowering of the freezing-point of phenol had yielded values between 200 and 600, and it was suggested that these values represent the true molecular weights of the units of a large aggregate which is stable in water but dissociates in phenol. This hypothesis does not agree with analytical evidence, and it is disproved by some experiments of E. J. Cohn and J. B. Conant, described in the July issue of the *Proceedings of the American National Academy of Science*. They found that the freezing-point depression depended on the method employed to dry the protein, and they therefore made use of the system phenol + anhydrous calcium chloride + hydrated calcium chloride. This has a sharp melting-point unaffected by small amounts of water and by the proteins, and it is concluded that no evidence exists for dissociation into units of low molecular weight.

MOISTURE AND SURFACE ACTION.—The current number of the Royal Society's *Proceedings*, 112, A 762, contains a communication by Prof. W. A. Bone, embodying the principal results of an inquiry, begun in 1908 and continued up to the present date, to determine whether or no moisture have any specific influence upon the combustion of carbonic oxide at a heated surface. The surfaces tried were: 1. Refractory firebrick at 500° C. 2. Granular nickel oxide at 200°. 3. Granular copper oxide at 210°. 4. Gold gauze at 240°. 5. Silver at 300°. 6. Porous porcelain at 500°. The experiments have been carried out with the exceptional care and caution characteristic of all Prof. Bone's work. It appears that the immediate consequence of progressive drying is always to increase the effect of the surface, presumably by removing the film of water molecules by which action is retarded. The ultimate effect, which is usually observed only after a prolonged drying, is to diminish greatly or even stop combustion. Although the ultimate effect of drying the metallic surfaces was practically to stop combustion, on readmitting moisture the activity of the surface was in time restored. The effect on porcelain was peculiar: ultimately not only was the influence of the catalyst greatly diminished but also it was not regained on reintroducing moisture.

A WIDE-FIELD BINOCULAR MICROSCOPE.—The advantages of binocular vision in microscopical work has led to an increased use of the binocular instrument, which consists of two juxtapositioned microscopes complete in themselves, by means of which the object is seen with a true stereoscopic effect. The introduction of a Porro erecting system to each of the two body tubes gives the further advantage that the image is viewed in its true position and not inverted or reversed. We have recently seen a specimen of a wide-field binocular microscope of this type which has been put on the market by Messrs. Bausch and Lomb, Ltd., of 37 Hatton Garden, London, E.C. The instrument is provided with 2 pairs of eyepieces and 3 pairs of objectives, by means of which magnifications varying from 7, with a field of view of 25·4 mm., to 30, with a field of view of 8 mm., can be obtained. Each objective is provided with centering screws, and each pair is mounted in a substantial base. The achromatic eyepieces have a very high eye-point, which permits prolonged observations to be made without undue fatigue. The microscope may be detached from its horseshoe base and placed directly on any surface which it is desired to examine. It may also be mounted on the end of a counter-balanced horizontal arm, which is capable of swinging round a vertical rod attached to a solid base or clamped to a bench. By means of these attachments, the microscope may easily be brought into position over a large area under examination. The instrument is thus adaptable to a great variety of circumstances and its range of usefulness for examining specimens under comparatively low magnification is almost unlimited.

HEAT CONDUCTION IN STEEL.—It is so generally believed that a fine-grained metal is essentially isotropic, that a paper by C. Benedicks, H. Bäckström, and P. Sederholm on "Anomalies in Heat Conduction as investigated in Spherical Steel Specimens," read at the Stockholm meeting of the Iron and Steel Institute, is of more than usual interest. The variation in the temperature gradient of uniformly heated steel spheres in different directions is so great as 1 : 8·5; the electrical resistivity, however, showed variations in different directions not exceeding the ratio 1 : 1·05. These variations in the thermal conductivity, of quite a different order of magnitude from those in the electrical conductivity, are probably connected with irregularities in the macrostructure. The thermal conductivity of a solid metal must represent two independent phenomena, (1) purely thermal, and (2) thermo-electrical. The latter involves eddy currents having such directions as to facilitate heat transfer by the Thomson effect. This part of the heat conductivity must be high for a metal possessing (*a*) a high electrical conductivity, and (*b*) a high Thomson coefficient. If a considerable part of the heat conductivity of, say, carbon steel is due to an inner thermo-electrical heat transfer, even small heterogeneities will thus be able to exert considerable influence on these thermo-electric currents, and may easily direct them into special preferential paths. From a practical point of view, there are two items to be specially considered. On one hand the transfer of heat in a massive steel piece will cause temperature irregularities of a possibly unfavourable character, especially as regards corrosion. On the other hand, the total heat transfer increases considerably with increasing dimensions of the metallic object on account of this electrical heat convection. In spite of the scarcity of available data, it seems justifiable to range the added dissolved elements in steel in the following order, so far as their influence on the thermal conductivity is concerned: Nickel, manganese, hardening carbon, aluminium, silicon, indicating that the thermal conductivity of iron is lowered least by 1 *atomic* per cent. of nickel, more by magnesium, and so on. Cementite carbon exerts only a slight influence.

begun until last year, when Mr. Frankfort carried it to its conclusion.

Naville's other scientific work related chiefly to the "Book of the Dead," of which he published the first critical edition. He was always specially interested in the religious side of Egyptian culture, and published a short work on "Egyptian Religion."

Naville was always proud of his knowledge of England, in the fortunes of which he took steady interest. In fact he was politically almost an Englishman, and showed his partiality by his impassioned defence of our action in the Boer War, when he published many pamphlets in all tongues in our favour, gaining rather an unenviable notoriety thereby on the Continent. He was a man of the courage of his opinions, and a keen polemist, as his attacks on "the Higher Criticism" of the Old Testament and his long disputes with the German Egyptologists on the question of the Semitic origin of the Egyptian language or the succession of the Thutmosids show; and in polemic he by no means always came off second-best.

Naville possessed many British and foreign degrees, was an Hon. F.S.A. and foreign associate of the Institute of France. During the War he was a prominent member of the Central Red Cross Committee at Geneva, over which he presided. No notice of him would be complete without a word regarding his devoted wife. Mme. Naville (*née* de Pourtalés) assisted him enormously in his work by copying descriptions, piecing together fragments of monuments, and so forth; her knowledge of Egyptology was considerable, and he always emphasised the value of her assistance to him in his scientific work. H. R. HALL.

DR. FRANCIS WARNER.

THE passing of Francis Warner has removed one of the last of the group of physicians and physiologists who studied movements and gaits, attitudes and postures in the 'seventies of the last century. Much of the study was conducted by means of pneumatic tubes connected with Marey's recording tambours. This phase of Warner's work was set out in his well-known work, "Physical Expression," and in his Hunterian lectures to the Royal College of Surgeons. Modern electrical methods and kinematography have modified and extended the conclusions then reached. Warner's clinical observations on the postures and movements of nervous and defective children made at the East London Hospital for Children, and later supplemented at the London Hospital, still remain standards for all observers.

In the early days of compulsory elementary education, it was soon found that many children were unable to profit by the facilities offered; in some instances, such as those who were blind or deaf, the need for special schools was obvious and was soon supplied in gradually increasing measure, but in the case of others with mental or physical defects, public opinion was more slowly influenced. It is largely to Dr. Warner's efforts in investigating the conditions of some 10,000 children in the London elementary schools and to his labours on a series of commissions that the present provision in London, unequalled anywhere in the world, came into being. Warner made a great point of observing the child at rest and while performing certain very simple movements, such as looking at an object or holding the hands straight in front of the body with the palms down. He directed attention to slack or convulsive postures of the hand which indicated nervous instability, to the knitting of the eyebrows, which might indicate nervous strain or hypermetropia, to muscular overaction of various kinds.

For some years Warner's tests formed a large part of the examination of children suspected of needing special education, and though they have been supplemented and in part replaced by tests of the Binet-Simon pattern, and other tests of power of performance and of adapting thought and movement to new requirements, they are still an essential item of a complete examination. Above all things, Warner stressed the point that an examination should be dynamic rather than static, that evidences of defect as shown by stigmata, then popular as supposed indices of mental status, were as nothing compared to that derived from actual movements and performances.

Dr. Warner was one of the first of a series of school hygienists and child students, who did much himself and, by his example and ready help and advice, laid the foundations of the present system of care for the health of scholars and the comfort and sanitation in the broadest sense of our schools.

PROF. CARLOS SPEGAZZINI died on July 1 of this year. He was born on April 20, 1858, at Bairo, Italy, and was a pupil of the late P. A. Saccardo at Padua. In 1878 he contributed his first paper on mycology, a study of coprophilous fungi, to the short-lived periodical *Michelia*, which Saccardo edited. He published a series of notes on the diseases of the vine and began to issue fascicles of dried specimens ("Decades mycologicæ Italicæ"). In 1880 he went to the Argentine as professor of natural history at Buenos Aires. The number of fungi recorded for the Argentine was then thirty-nine. Spegazzini worked this virgin soil to the full and until his death made continuous contributions to the mycological flora, extending his investigations to most countries of South America. His work was that of a general systematist, and in the thousand or so new species he described, practically all groups are represented. His work appears to be much more carefully done than is usual in such mass production, and is illustrated by clear and attractive drawings. Spegazzini not only accomplished an enormous amount of mycological work but also published numerous papers on Phanerogams, specialising during the last few years more particularly on Leguminosæ. Odd papers on all sorts of subjects testify to his great interest in general natural history and science.

WE regret to announce the following deaths:

Sir Edward Busk, sometime Vice-Chancellor and Chairman of Convocation of the University of London, and a member of the governing bodies of the Imperial College of Science and Technology and of several well-known schools, on October 29, aged eighty-two years.

Mr. R. N. Lennox, formerly assistant to the late Sir James Dewar at the Royal Institution, on November 1.

News and Views.

THE King has approved of the following awards this year by the president and council of the Royal Society: A Royal medal to Sir William Hardy for his pioneer work on colloidal chemistry and the theory of lubrication. A Royal medal to Prof. A. V. Hill for his distinguished work on the physical and chemical aspects of muscular contraction. The following awards have also been made by the president and council: The Copley medal to Sir Frederick Hopkins for his distinguished and fruitful work in biochemistry. The Rumford medal to Sir Arthur Schuster for his services to physical science, especially in the subjects of optics and terrestrial magnetism. The Davy medal to Sir James Walker for his work on the theory of ionisation and ionic equilibria in solution. The Darwin medal to Dr. D. H. Scott for his contributions to palæophytology, particularly in relation to the period of coal. The Hughes medal to Admiral Sir Henry Jackson for his pioneer work in the scientific investigation of radio-telegraphy, and its application to navigation.

THE following is a list of those recommended by the president and council of the Royal Society for election to the council at the anniversary meeting on November 30:—*President*—Sir Ernest Rutherford; *Treasurer*—Sir David Prain, *Secretaries*—Mr. J. H. Jeans and Dr. H. H. Dale; *Foreign Secretary*—Sir Richard Glazebrook. *Other Members of Council*—Sir Hugh Anderson, Dr. F. W. Aston, Prof. L. Bairstow, Prof. F. O. Bower, Sir Archibald Garrod, Prof. E. J. Garwood, Sir Thomas Heath, Prof. J. P. Hill, Dr. P. C. Mitchell, Prof. R. Muir, Sir John Parsons, Sir Robert Robertson, Mr. A. A. C. Swinton, Sir Gilbert Walker, Sir James Walker, Mr. W. C. D. Whetham.

THE announcement that Sir Alfred Yarrow has made a donation of 10,000*l*. to the funds of the British Association is of particular significance, as showing the appreciation of scientific study and research by a great leader of industry. A few years ago another pioneer of engineering science—Sir Charles Parsons—made a like gift to the Association; and it may be hoped that the generous lead thus given will be followed by other representatives of progressive industry which benefit directly or indirectly by the advancement of scientific knowledge. Sir Alfred Yarrow, feeling that the present urgent needs of the British Association, in its work for science, should receive precedence over provision for the distant future, has made it a condition that his gift should be expended, as to both capital and interest, within a period of twenty years. Sir Charles Parsons has expressed himself similarly with regard to his gift. Through these gifts, and by the provision for their use in a single generation, the Association will be able to strengthen its powers of obtaining general attention for the objects of science, and of affording more steady assistance to scientific research in directions indicated as desirable during the deliberations of its various sections at the annual meetings.

WE learn with great pleasure that no less an artist than Sir William Orpen has consented to paint the portrait of Prof. J. A. Fleming, whose many friends and admirers, as we have already announced, are raising a fund for this purpose. The portrait is to hang in University College, London, with which Prof. Fleming has been so long and honourably connected, and no doubt Sir William Orpen's willingness to paint the picture is in part due to the fact that Sir William Orpen himself received his early artistic training at the Slade School, which is part of University College. A replica of the portrait is also to be presented to the Institution of Electrical Engineers, as representing the great scientific profession and industry for the advancement of which Prof. Fleming has done so much. In the popular view no doubt Prof. Fleming is chiefly known as the inventor of the famous 'valve', which, adapted as it has been in many forms to radio telegraphy and telephony, has made broadcasting possible. His other great activities as a teacher, and especially as a writer, must not, however, be forgotten. His many works, on alternating electric currents, on electric lamps, on electrical testing, and on electric wave telegraphy, are standard volumes, while his reminiscent account, "Fifty Years of Electricity," makes the most delightful and inspiring reading. It is an open secret that many years ago Prof. Fleming would, but for his unfortunate deafness, have been elected president of the Institution of Electrical Engineers, and to add to his many other qualifications for honour, he is well known as one of the most skilled and popular experimental lecturers on electrical subjects in the world. The subscription list for the portrait is still open, and intending contributors are asked to send their donations as early as possible to the honorary secretary of the Fund, Prof. W. C. Clinton, University College, Gower Street, London, W.C.1.

THE new science laboratories of the University College of North Wales, Bangor, were declared open on Tuesday, November 2, by Sir Joseph Thomson. A tour of inspection of the laboratories was made in the morning, and in the afternoon Sir Joseph addressed a gathering of about eighteen hundred people in the Pritchard-Jones Hall of the College. The science laboratories form part of the North Wales Heroes' Memorial, and consist of five separate buildings, which house the six Departments of Physics, Chemistry, Botany, Zoology, Agriculture, and Forestry. When completed, the whole memorial, which includes a memorial arch and a bursary fund in addition to the laboratories, will have cost a sum approaching 150,000*l*. Of this amount about 120,000*l*. has already been subscribed. The afternoon meeting was presided over by Lord Kenyon, president of the College. He read and presented to Sir Joseph Thomson an address in album form, and the laboratories were then thrown open to the public. The buildings are of one storey, with the exception of the agricultural block, which has two storeys. Each block covers a floor space of about

10,000 square feet. All the heating, gas, water hydrant, and electric mains which serve the different rooms are run in brick trenches under and between the buildings. By this means all the pipes and cables are readily accessible. Special mains have been laid by the Corporation. The physics block is furnished with a liquid air plant, and accommodation is provided for about 100 students and a dozen research men. Each research room is furnished with electric power supplies of 400 volts D.C., 200 volts D.C., 150 volts from a battery (any voltage from 2 to 150 volts in steps of 2 volts can be obtained), and alternating current at about 220 volts and 50 cycles. The main laboratories, of which there are three, and the lecture rooms are provided with the same electric power supplies. The floors are of concrete, which is covered with cork lino for insulation purposes. The cable carrying the electric power and the battery leads run along shallow ducts in the floor. The department is furnished with a well-equipped workshop. A small hut has been erected a few yards away from the main physics building in which measurements in radio-activity will be conducted. The general lay-out and equipment of the other blocks are similar to those of the Physics Department.

THERE has recently appeared in the *Daily Express* a series of articles by leading men of science under the general title of "The Mystery of the Universe." The contributors are the Astronomer Royal (Sir Frank Dyson), Profs. Plummer, Eddington, and Andrade, Sir Oliver Lodge, and the Bishop of Birmingham (Dr. Barnes). The first four writers confine themselves in the main to an exposition of the leading facts and generalisations of modern physics and astronomy; Sir Oliver Lodge attempts "to weave together the four preceding articles and draw scientific conclusions"; and the Bishop of Birmingham considers the same material in relation to the much-discussed question of the connexion between religion and science. It is a matter for satisfaction that one of the principal London newspapers should publish such articles as these, and we hope the example will be followed by other daily papers from time to time. The influence of science on the life of the community is far greater than is commonly realised, and it is in every way desirable that at least the general outline of current research should be given as wide a publicity as possible. Nor can it be too strongly emphasised that this should be done by experts, and not by the ordinary reporter who, however well instructed he may be, has in practice often failed lamentably to give even an intelligible, much less an accurate, account of scientific matters. We offer our congratulations to the *Daily Express* on the excellent lead it has given in this direction.

A NOTEWORTHY feature of the series is that it deals exclusively with the physical sciences. Of the six contributors (considering only their scientific qualifications), three are astronomers, two physicists, and one a mathematician. This would perhaps seem fitting if the utilitarian aspects of science were in question, but they are scarcely mentioned; the emphasis, as the title indicates, is laid on the unknown and the unapplied, and the fundamental relationships between science, religion, and philosophy form the background, concealed or expressed, of the whole. The exclusion of biology is to be regretted, for a symposium on the mystery of the universe which includes no discussion of life from the scientific view-point, must necessarily be unbalanced. The expressed conclusion that physical discovery brings us no nearer to a solution of the problem of the nature of life and mind makes the omission even more striking. If, however, we may take the subjects dealt with, and the manner of their treatment, as indicative of the trend of public thought in these matters, the change from the bitter squabbles of the last century between would-be advocates of religion and science is as welcome as it is complete. There is no longer a *conflict* between religion and science; there is a *relationship*, perhaps not yet discovered completely, which we seem to be able to approach with greater chance of success along the road of cosmic physics than along that of biology. This is, perhaps, the greatest advance which scientific philosophy has yet made.

THE authorities of the Science Museum at South Kensington have instituted a series of exhibitions of apparatus used in, and results obtained by, recent research, and the first of the series is now open to the public free. It deals with work which has been carried out at the National Physical Laboratory in the Departments of Physics, Metallurgy, and Engineering. The new hygrometers for cold stores, new thermal insulators, protectors against X-rays, new high vacuum pumps, apparatus for predetermination of the acoustical properties of halls, the composition of steels and other alloys, and the detection of defects in their interior by X-rays, furnaces for metallurgical investigations, and methods of testing the lubricating properties of oils under pressure are all shown, and later in the month it is proposed to show some of the results which have been obtained by the Adhesives Research Committee of the Department of Scientific and Industrial Research. These exhibitions will enable the general public to understand readily the advances which are now being made by research workers in science and how they may be applied in industry.

FOR some time past many students and others interested in Africa have felt that a special organisation, framed on an international basis, is urgently needed for the study of African linguistics and culture. Such an institution was desirable not only to continue work such as that carried on by the Hamburg Colonial Institute before the War, but also to collate, supplement, and extend the work of existing organisations such as, in England, the African and Geographical Societies and the Royal Anthropological Institute. The aim of the projected organisation was practical as well as scientific: it was intended not merely to promote African studies in the widest possible sense; it was proposed that it should, as the result of such studies, lay down lines for, and participate in, educating and training the African

native, by stages suited to his mentality and culture, for the inevitable clash of cultures when he has to meet conditions arising out of the European occupation and exploitation of his country. As a result of invitations issued after a conference held in London in September 1925, a considerable body of influential support has been obtained. The International Institute of African Languages and Cultures, as the new organisation has been named, will include among its members accredited representatives of the African Society, the Advisory Committee on African Education of the Colonial Office, of which the Secretary, Major Hans Vischer, has accepted the vice-directorship of the Institute, the Royal Anthropological Institute, the School of Oriental Studies, the Advisory Committee on Bantu Studies in South Africa, the National Research Council of the United States, the principal universities and learned societies interested in African studies of France, Belgium, Italy, Germany, Austria, and Sweden, and the missionary societies, both Roman Catholic and Protestant. Sir Frederick Lugard will act as chairman of the executive council. M. Delafosse, the well-known authority on Africa, and Dr. D. Westermann, equally well known as an authority on African linguistics, will be joint directors. An extensive programme of work, to a great extent but not entirely, linguistic, has already been mapped out. Further particulars of the Institute and terms of membership may be obtained from the temporary offices, Lever House, Blackfriars, London, E.C. 4.

THE *Rand Daily Mail* for September 20 contains a notice of a conference to be held at Potchefstroom which will endeavour to prove scientifically "that no reconciliation is possible between Scripture and evolutionary science, and that evolution is a false dogma of pagan origin and anti-Christian character." Among the points to be proved are the following: That the Bible alone explains the origin, essence, and final purpose of things. That there is a generally accepted theory of evolution, but there are no experimental proofs. That the facts of palæontology do not point to the gradual development of forms, but are explicable on the hypothesis of catastrophic change. That the fabulous age of the earth ascribed to it by geologists is an uncalled-for speculation. That the intimate connexion between man and the apes has not yet been proved. With regard to man and the apes, that descent is not the relationship between them has already been pointed out to the Fundamentalists of America by Prof. Osborn; but as for the other points raised, it is not our business to refute, but to direct attention to them If they were raised seriously in the interests of scientific truth, there would be no cause for uneasiness; but as this is evidently a definite effort on the part of a theological faction to influence and organise ill-informed public opinion, we must regard it in a very serious light. Those who suppose that the cause of religion is helped by this sort of thing are deceiving themselves; there is nothing that can possibly damage it more than this ill-advised propaganda. It is especially dangerous in countries where democratic institutions are combined with a not very high standard of general education. Sinister possibilities lurk behind this agitation, obscure as it may seem to those in England. Democracy, when it takes to persecution, can rival Torquemada, for from its verdict and sentence there is no appeal.

IN the *Nineteenth Century* for October Sir Frank Beaman has an article on "Psychology and Crime." He seems to be annoyed at the suggestion that psychology can have anything to offer towards the understanding of the criminal. With the actual administration of the law as it stands the psychologists would be quite in agreement with the writer. If the facts prove incontestably that A killed B, and if it is the law that any person who kills another is to be hanged, there is no more to be said. In law, though, as in other branches of knowledge, difficulties soon arise as to the exact connotation of the words and the exact sphere of application. It should be noted, too, that insanity is always "legal insanity"; insanity has a purely legal significance and has no place in medicine. Nearly half the article is by way of introduction, and we are given Sir Frank Beaman's views, expressed with dogmatic fervour, on the human factor in various sciences, political economy, the statistical method (which is very fallacious), the ignorance of medical practitioners (they do not know why some otherwise quite normal people are literally poisoned by eggs or by gooseberries), the variety of the human body, Mendelism (greatly over-vaunted), evolution (a question-begging term), psychology (the least trustworthy of the sciences), psycho-analysis (morbid and sensational), spiritualism (pretentious), the morbid taste of the general public, etc. The actual problem seems a little lost against this background. The general method is not unlike the Bellman's "What I tell you three times is true." There is something to be said for the more usual form of the statistical method.

THE Greenland expedition of the University of Michigan returned to America in September under the leadership of Prof. W. H. Hobbs, who gives, in *Science* of October 8, a short account of the work done during the summer. The base of the expedition was on Maligiak Fjord, fifty miles east of Holsteinsborg, where a meteorological station was set up. Pilot balloons were sent up to test the direction of the upper air currents. Some ninety balloons were traced to an average height of 7000 metres, several to 10,000 and one to 14,000 metres. Three meteorographs, with records intact, were recovered from *ballons-sondes* which had reached considerable elevations, in one case more than 1500 metres. An exploring party under Prof. Hobbs ascended the ice-sheet 100 miles east of Holsteinborg. Pilot balloons were traced to a maximum height of 5500 metres and wind observations were made at three-hour intervals at the surface. Self-registering meteorological instruments have been left at Holsteinborg to be used throughout the winter. Tidal observations were also undertaken. Prof. Hobbs plans to return to Greenland next summer with a larger expedition and to continue his studies of Greenland winds both on the margin and in the interior of the ice-sheet.

AN interesting correspondence in recent issues of the *Times* shows that the sound of the 'concentration shoot' at Portland on Saturday afternoon, October 30, was heard at great distances in the midland counties. There are records from Long Wittenham, near Abingdon (98 miles from Portland), Shipton-under-Wychwood and Shotover in Oxfordshire (103 miles), Bourton-on-the-Water in Gloucestershire (104 miles), Eton and Chertsey (108 miles), Bosbury in Herefordshire (112 miles), and Dunchurch near Rugby (141 miles). The wind at three of these places was roughly in the direction opposite to that of Portland. Moreover, the sounds were very distinct. At Eton and Bosbury the observers were working in their gardens. At Shotover, according to the president of Trinity College, Oxford, "the noise was so loud that we thought that it might proceed from some explosion at the Morris Motor Works, which lie to the south of the hill." The remarkable point about these observations is not so much the great distances of the places, but the unusual loudness of the sounds, which suggests that the places mentioned lie in an outer sound-area separated from the source by a silent zone.

THE paper read by Messrs. J. Beard and T. Haldane to the Institution of Electrical Engineers on November 4 was a very timely one, as they discuss the possibility of standardisation in the design of the systems used for distributing electric light. It seems certain that in ten years' time the supply of electricity to consumers in Great Britain will be at least doubled. It is very advisable, therefore, that piecemeal extensions of the various supply networks such as have sufficed in the past should no longer be made. The present time is most suitable for getting all the benefits of standardisation. The suggestions made are very helpful. Engineers have just adopted 230 volts as the standard pressure. One of the reasons for adopting this somewhat odd number is that when a three-phase system is used and 230 volts is used for lighting, 400 volts is available for power. As one of the pressures is equal to the other multiplied by the square root of three, it is impossible to make them both decimal In the system of distribution proposed by the authors, the distributing pressure from the substation would be at 11,000 volts. It would then be transformed down to 400 volts and 230 volts by a four-wire three-phase distributing system. Continuity of supply is secured by having a duplicate high voltage supply. The low voltage cables are very convenient, having four equal cores inside a lead covering. The costs, however, which are independent of the load, are very large, the main item being the high cost of excavation for the distributor cables. This accounts for the rapid rate at which the total costs per unit delivered decrease with the load. If the load is doubled they are reduced by about one quarter. In our opinion, the adoption of a standard system such as that suggested by the authors would be in the interest both of the industry and of the country.

A PROPOSAL for a meteorological cruise in the Atlantic in 1927 is suggested in the *Meteorological Magazine* for September. The cruise is to honour the memory of Colonel Chaves, the founder of the Meteorological Service of the Azores. The meteorological observations from the Azores were transmitted free by the Portuguese Government and have in the past added much to the possibility of successful forecasting of the weather in the British Isles. There is an eclipse of the sun on June 29 next year, of which the line of totality crosses the Irish Sea, and this is suggested as a starting-point. It is proposed that the cruise should occupy about 25 days, beginning with June 28. Readers of the *Meteorological Magazine* and others disposed to join in such a cruise are asked to communicate with Mr. C. J. P. Cave, vice-president of the Royal Meteorological Society, or with Sir Napier Shaw, lately Director of the Meteorological Office.

To the four series of picture postcards devoted to precious stones, and the two series representing decorative stones, the British Museum (Natural History) has now added two further series (D9 and D10) of cards illustrating crystals (London: British Museum (Natural History). 1s. each set). As before, each set consists of six attractively printed cards, accompanied by an explanatory leaflet. The leaflet includes a masterly little essay on crystallography, ranging in its scope from Steno's fundamental law of angles, announced in 1669, to the work of Laue and the Braggs on X-ray analysis. The first set of cards gives examples of cubic, tetragonal, hexagonal, and rhombohedral crystals; and the second of the remaining systems and of twin-crystals. Both in accuracy and attractiveness of reproduction, and in educational value, these new series fully maintain the high standard achieved by previous issues.

SENATORE G. MARCONI has been elected an honorary member of the Institution of Electrical Engineers.

DR. W. H. STEAVENSON, who contributed the article on Mars to our issue of November 6, has been elected president of the British Astronomical Association in succession to the Rev. C. D. Percy Davies.

IT is gratifying to note that Mr. Mackay, who for several seasons past has been engaged in excavation at Kish in Mesopotamia, has been engaged by the Archæological Survey of India to work on the sites in the Indus Valley on which remains of the earliest culture yet known in India, including the famous pictographs of Sumerian type, were discovered. Mr. Mackay's knowledge of Mesopotamia will be invaluable in these excavations should further material bearing any resemblance to Sumerian antiquities be brought to light.

THE Trustees of the Beit Fellowships for Scientific Research announce that Sir Otto Beit has promised to hand over to them a further sum of 15,000*l*. This will enable the Trustees to make all their appointments to fellowships for two years, instead of one year as has happened in the past. The fellowships are tenable at the Imperial College of Science and Technology, South Kensington, and since the foundation of the fund in 1913 there have been eighteen appointments. The extension of tenure will add considerably to the value of the fellowships from the point of view of the promotion of fundamental research.

SIR FLINDERS and Lady Petrie and other members of the British School of Archæology will leave in the course of a few days for Palestine, where the winter will be spent on excavating Egyptian remains in the southern area of that country. As announced since last season, the School, for the present at any rate, will discontinue work in Egypt itself owing to the difficult conditions in which archæological research has now to be carried on. While it is not possible at this moment to mention any specific object in view, there are many problems requiring investigation. The work of the expedition will depend upon circumstances; but no doubt Sir Flinders Petrie hopes to secure further evidence bearing upon the Badarian culture, which, on his view, reached Egypt through Palestine.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A professor of physiology in Presidency College, Calcutta—The Secretary to the High Commissioner for India, 42 Grosvenor Gardens, S.W.1 (November 20). A Principal of the Municipal Technical College, Dewsbury—The Secretary for Education, Town Hall, Dewsbury (November 20). A Warden of the Farm Institute and Experimental Station at Askham Bryan, near York—The Joint Clerks, Yorkshire Council for Agricultural Education, County Hall, Beverley (November 30). An assistant horticultural instructor under the Kent Education Committee—The Director of Education, Springfield, Maidstone (November 24). An assistant lecturer in chemistry at University College, Swansea—The Registrar, Singleton Park, Swansea (November 27). A Vice-Warden for Ashburne Hall of Residence for Women Students of Manchester University—The Honorary Secretary, Ashburne Hall, Fallowfield, Manchester (November 29). An assistant lecturer in agricultural chemistry in the University of Leeds—The Registrar (November 30). A radiologist in the medical department of the Federated Malay States—The Private Secretary (Appointments), Colonial Office, 38 Old Queen Street, S.W.1 (December 4). An assistant in the department of zoology of the National Museum of Wales—The Director, National Museum of Wales, Cardiff (December 4). A professor of physical chemistry in the University of Bristol—The Registrar (December 10). A teacher of geography and mathematics at the Borough Polytechnic Institute—The Principal, Borough Road, S.E.1.

Our Astronomical Column.

COMETS.—Neujmin's periodic comet, 1916 II., has been detected by its original discoverer, Mr. Neujmin (presumably at the Simeis Observatory, Crimea), on Nov. 5 at $1^h\ 37{\cdot}0^m$ U.T. in R.A. $10^h\ 10^m\ 56^s$, N. Decl. $18°\ 20'$, magnitude 14·5. The date of perihelion deduced from the R.A. is Jan. 15·93, 1927, from the Decl. Jan. 15·80, 1927. The evidence is, on the whole, against the identity of the doubtful object photographed in 1920 with the comet, but is not yet decisive. The comet is approaching both sun and earth, so should become considerably brighter. The following corrected ephemeris is for 0^h U.T.:

		R.A.		N. Decl.		log r	log Δ
Nov.	16	10^h	$43{\cdot}1^m$	14°	36′	0·1680	0·1411
	20	10	54·9	13	1		
	24	11	6·7	11	22		
	28	11	18·5	9	38		
Dec.	2	11	30·2	7	50	0·1546	0·0922

A doubtful object (comet or minor planet) of the twelfth magnitude was discovered by Prof. J. Comas Sola, of Barcelona, Nov. $5^d\ 0^h$, R.A. $2^h\ 56^m\ 36^s$, N. Decl. $6°\ 31'$; daily motion -1^m, south 3′. Later: Mr. B. M. Peek and Mr. G. Merton confirm the cometary character of the observations on the morning of November 10.

GIACOBINI'S COMET AND THE METEORIC DISPLAY OF OCTOBER 9.—Mr. W. F. Denning writes: "It appears certain that on October 9 the earth intersected a point in the orbit of Giacobini's comet, but that this point was about two months in front of the comet. The latter is due at perihelion on about December 10 next, so that taking the rate of velocity of the meteors at $14\frac{1}{2}$ miles per second, as computed by the Rev. M. Davidson, the comet's place on October 9 was about 77 millions of miles distant along the orbit from the point of intersection with the earth on the above date. In 1900 the nearest approach of the two orbits was about $5\frac{1}{2}$ millions of miles, but perturbations since that date have sufficiently disturbed the orbit of the comet to make it intersect that of the earth at this return. Had the comet arrived at perihelion two months earlier this year, the conditions would then have favoured a meteoric display of exceptional grandeur. Dr. A. C. D. Crommelin's position for the cometary radiant is $265° + 54°$, Mr. Prentice's radiant for the meteor shower was $263° + 54°$, and the radiant of the fireball of October 9, as deduced by Mr. King and myself from a number of observations, is $262° + 55°$, so the agreement is very good and near β Draconis."

MARS.—*Popular Astronomy*, Nos. 7 and 8, contain Report No. 37 of Prof. W. H. Pickering on the 1924 apparition of Mars. He commences with a discussion of the rotation period, and concludes that when allowance is made for Marth's change in the adopted position of Mars' axis in 1896, the period now generally employed, $24^h\ 37^m\ 22^s{\cdot}65$, represents the observations of the last fifty years. The research is complicated by the considerable changes of size and shape to which some of the dusky markings are liable.

In discussing various drawings of 1924, Prof. Pickering notes that there is considerable agreement among observers as to the position of the canals, but there is much personality as to the width assigned to them. An objection frequently brought by M. Antoniadi against the objective reality of the canals, based on their being drawn straight when far from the centre of the disc, is answered by a careful observation of the canal Amenthes Thoth on October 19 and 20, 1924, it was respectively 16° east and 16° west of the centre of the disc. The curvature was clearly reversed in the two drawings, which corroborates the objective reality of the marking, and its close adherence to a great circle.

Proceeding to the question of the nature of the canals, Prof. Pickering notes his own opinion that the supposition of their being artificial explains more facts than any other, and that the regular patterns, such as pentagons and stars which were seen in 1892, 1907, and 1924, point in the same direction. He does not claim it as more than an hypothesis, but he considers that it is rendered more probable by his own observations of Martian clouds in 1922, and Dr. Wright's photographs in infra-red light in 1924, which indicated a considerable amount of atmosphere.

Research Items.

AN EARLY ESKIMO CULTURE IN ALASKA.—In a communication issued by the Victoria Memorial Museum, Ottawa, Mr. Diamond Jenness, Chief of the Division of Anthropology, reports on the results of four months' field-work in Alaska, where he excavated ancient ruins and studied local dialects with the object of determining the origin and antiquity of an Eskimo civilisation which has left traces in Canada extending from the Mackenzie River Delta to Hudson Bay. At Wales, the point of Alaska nearest to Asia, ruins were discovered belonging to four distinct periods, all preceding the discovery of Alaska by Europeans. The remains of the second period resembled very closely those of the oldest known ruins of Arctic Canada. Excavations on the Diomede Islands confirmed those at Wales, and revealed a still earlier culture, of which there is no trace in Canada. The most characteristic feature of this culture was a style of curvilinear engraving unlike anything known of Eskimo art elsewhere, ancient or modern. Its source must be sought either among neighbouring Indian tribes or in north-east Asia. In regard to the former suggestion, it is to be noted that local Eskimo folklore and traditions show strong Indian influence, to be seen also in the masked dances, the use of body armour of bone or ivory, and certain sounds in the language. An antiquity of some 1000 to 1500 years is tentatively assigned to the earliest culture.

DIDINGA WITCHCRAFT.—In *Sudan Notes and Records*, vol. 8, Mr. J. H. Driberg, in the course of notes on Didinga customary law, refers to the penalties imposed on witches and wizards, and gives some indications of the character of the belief among these people. The practice is very prevalent and is usually associated with the use of poison. The influence of the evil eye is greatly feared, but does not belong to witchcraft proper, to which, however, the habit of bestiality, presumably a sexual abnormality, is attributed as a practice intended to injure live-stock. The wizard attains his object by dances. To secure the death of a man, a dance is performed at night at his door; to injure his crops, the dance takes place in the crops, but not necessarily at night. The dead are disinterred by wizards, who are fond of dancing by new graves. A wizard caught performing his dances invariably begs for compassionate treatment and proffers a spear, an axe, or a bracelet, which, if accepted, is carefully hidden away. Notwithstanding promises of amendment, the wizard continues his dances, the evidence in the form of the objects accepted as ransom accumulating until the wizard is seized and arraigned before a council, by which he is sentenced to death and hanged. A goat is sacrificed at his funeral. The wizard's powers are transmitted to another, with or without his knowledge, by a certain drug served in a pot of beer. Involuntary witchcraft so induced is an adequate plea at trial provided the principal wizard who was responsible is denounced. The wizards are all highly strung and hysterical, and are capable of self delusion to such an extent that they believe themselves invisible when dancing on cultivated ground.

FISH PASSES.—In a very interesting paper (*Fisheries, Scotland, Salmon Fish.*, 1926, II. Edinburgh and London: H.M. Stationery Office, 4*s.* 6*d.* net), Mr. W. L. Calderwood gives accounts of different salmon passes that have been constructed from time to time. These descriptions, together with photographic illustrations, show the gradual evolution of the modern type of pool pass from the original ladder pass, through such forms as the Bracket pass and many others fitted with baffle arrangements. There are many factors to be borne in mind in building a pass, and it is largely from the comparative failure of previous types that the most modern forms have been evolved. Of special importance in the British Isles is the fact that spring-running salmon are not jumpers, and will not face a strong rush of white superaerated water when that water is cold (below 40° F.). For such fish, then, the gradient of the pass must be easy, with no falls necessitating jumps; the velocity also must be sufficiently slow and regular to allow plenty of black water. Of paramount importance is the position of the outflow of the pass; this should be near to the obstruction to be avoided and close to the usual lie of running fish; it should also discharge a sufficient flow of water to be attractive. The protection of the inflow from flood water and the carrying of stones and gravel into the pass is necessary. The most modern pass consists of a series of pools with only slight drops between, a protected entrance for the water and an arrangement of movable sills, worked by floats, ensuring the passage of the same flow of water through the pass at all levels of the river, whether in flood or drought. Plans of two new passes designed by Mr. Rook for the river Tummel are given.

FUNGAL SYMBIOSIS.—In a communication to the Reale Accademia delle Scienze dell'Istituto di Bologna (*Rendiconti*, Vol. 29), Prof. Fausto Morini describes three examples of the parasitic existence of one fungus on another. In the case of a spermogonial form of *Phyllosticta parassitica* growing on the perithecia of *Uncinula salicis*, the injurious effect of the parasitic organism on the development of the host is apparent from the diminished number and size of the ascospores. In the second case, the host consists of a species of mucor resembling, in the ramification of the sporangiophore hyphæ, a reduced and modified form of *M. racemosus*, although it appears to be allied also to *M. corymbosus*. The parasite, a species of Piptocephalis, differing slightly from *P. Freseniana*, especially in the characters of the haustorial hyphæ, penetrates the mycelial hyphæ of the mucor and branches freely therein. The third example is that of *Piptocephalis microcephala* on *Pilobolus crystallinus*. A scheme of classification of the principal fungal symbioses is appended to the paper.

ABNORMAL FERN PROTHALLI.—Miss E. Schindler has found that the spores of *Asplenium septentrionale*, *A. trichomanes*, *Dryopteris filix mas*, and *Polypodium vulgare* will germinate when submerged beneath a liquid nutrient medium. Under these conditions they give rise to long filamentous structures, the cells dividing generally only by walls in one plane. These filamentous prothalli branch fairly freely. Neither the normal meristematic growth of the prothallus nor the formation of archegonia, follows in these prothalli unless they succeed in raising themselves out of the liquid medium into the damp air above it; antheridia occur sometimes on the submerged prothalli when growing in nitrogen-free culture media. This work was carried out by Miss Schindler at Cracow, under the guidance of Prof. Rouppert, and is published in the *Bulletin International de l'Académie polonaise des Sciences et des Lettres*, No. 5-6 B, June 1925.

POTATO MOSAIC AND TEMPERATURE.—The so-called 'virus' diseases are occupying considerable attention at present, and although 'leaf-roll' of potato is the form to which is attributed the greatest

potency in inducing degeneration in English potato crops, those forms of mottled or puckered foliage connected with 'mosaic' are not infrequently reported. Considerable interest therefore attaches to the American experience recorded by C. M. Tompkins (*Phytopathology* **16**, 581-610, September 1926) as the result of his work at the Department of Plant Pathology, University of Wisconsin. Tompkins reports that air temperatures of 23° to 24° C., even though only occasionally prevailing, are sufficient to mask completely the existence of mosaic in diseased stock when judged by the ordinary diagnostic symptoms. If the plants are afterwards kept at lower temperatures, characteristic mosaic symptoms are again developed. On the other hand, under histological examination the leaves of the diseased plants in which the disease is masked are said to show marked deviation in structure from healthy leaves, both palisade and spongy parenchyma of the mesophyll being very regularly arranged so that air spaces are almost completely eliminated.

FOSSIL LEAF-BEDS IN VICTORIA.—In Miocene times in Victoria, the country adjacent to the shoreline, then 40 to 70 miles inland from the present coast, was in places marked by a lacustrine phase. It was then that large lake deposits were formed consisting of ferruginous mud or slime, fine pipe-clay or silty material. Into these lakes were swept large quantities of leaves of the Miocene forest and brush. The leaves are well preserved and are now found in the ironstones and pipe-clay deposits in seven localities in Victoria. These fossil leaf-beds have been found at Pitfield, Bacchus Marsh, Berwick, Bogong, Cobungra and Dargo Through some recent studies of the Tertiary flora of the sandstone and quartzite of Narracan in Gippsland (*Proc. Roy. Soc. Vict.* Vol. 38, 1926, pp. 183-191), Frederick Chapman has added several new forms to the known list of fossil plants from the earlier localities mentioned. The Narracan flora comprises a eucalyptus of a modern coastal type, the myrtle beech (Nothofagus), the flame tree (Sterculia), the kanooka (Tristania), the cinnamon, and other Australian genera. Although of Miocene age, these deposits contain several types of leaves still existing in Victoria, mingled with others now belonging to areas situated in lower latitudes, as New South Wales and Queensland. Another point clearly established in this paper is the relatively older age of the Narracan leaf-beds as compared with the leaf beds in the brown coal of Morwell and Yallourn

MESOZOIC GEOLOGY OF ALASKA.—*Bulletin* 776 of the U.S. Geological Survey, by G. C Martin, 1926, contains a valuable record of the advances made in Alaskan geology during the present century. Mesozoic history provides by far the most important clues to the present structure of the Peninsula, and has a direct bearing on the mineral resources. At the end of the Palæozoic there was a widespread emergence of the land accompanied by intense and long-continued vulcanism. Profound marine submergence followed in Upper Triassic times, but the sea withdrew from the entire area during the late Triassic and early Jurassic, and the rocks already deposited were folded. Marine transgression began afresh in the Lower Jurassic, and widespread vulcanism again broke out, culminating in great granitic intrusions with accompanying formation of ore deposits. The Jurassic was brought to an end with vigorous uplift and erosion. The sea again swept over Alaska in Lower Cretaceous times, receded at the beginning of the Upper Cretaceous, and then advanced again. Finally, the submergence of the Upper Cretaceous slackened, marshes were formed and coal-beds deposited. The end of the Mesozoic and the beginning of the Eocene were marked by the complete withdrawal of the sea, a renewal of folding movements and intense vulcanism, intrusion, and mineralisation. A geological map of Alaska is now in preparation and will shortly be available.

ECONOMIC GEOLOGY OF CANADA.—The Geological Survey of Canada has published on this subject an extremely valuable and well-illustrated memoir by G. A Young (No 1 of the *Economic Geology Series*). Having regard to its physical features and geological structure, Canada is naturally divisible into six major regions. The Arctic archipelago and the Hudson Bay lowland contain extensive deposits of coal. The Canadian Shield is a U-shaped area bordering Hudson Bay, made up of ancient rocks, in which have been developed the Sudbury nickel-copper mines which are the world's chief source of nickel, the spectacular gold mines of Porcupine and Kirkland Lake, and the rich silver deposits of the Cobalt district. In the Appalachian and Acadian region are the asbestos deposits of south-eastern Quebec and the coal-fields of Nova Scotia. In the St. Lawrence region to the south occur the salt beds and petroleum fields of Ontario. The Interior Plains lie between the Canadian shield and the mountains to the west, and are underlain by vast reserves of coal. The Cordilleran region borders the Pacific, and in addition to extensive coal-fields it is noteworthy for the wealth of its placer gold-fields, copper-gold ores, and silver-lead-zinc ores. It is noteworthy on the negative side that Canada does not rank as a producer of aluminium, tin ores, or of precious stones. An excellent geological map accompanies the memoir, and a mineral map in which every important occurrence is numbered; an annotated list gives details of each.

TWILIGHT PHENOMENA.—In the *Denkschriften der Schweizerischen Naturforschenden Gesellschaft*, **62**, 1926, there are two memoirs only, of which the first, of 190 pages, is by P Gruner. It is the second of a series by this author, under the general title of "Contributions to the knowledge of twilight phenomena and of the Alpine glow"; the former paper (of 154 pages) gave a historical-chronological review of Swiss observations and publications on twilight colours and the Alpine glow The present paper is a similar review of non-Swiss observations and publications on twilights, atmospheric-optical disturbances, and related phenomena As the extent of the memoir indicates, the author has cast his net widely and summarises an immense mass of literature, which he also indexes under the names of authors, with references, forming a bibliography. The subject is so large when the term "related phenomena" is interpreted generously, as in this case, that completeness is neither attained nor to be expected. But the memoir should be of real value to investigators whose work bears on these fields

THE LAW OF SPEED RECORDS.—In 1906, Prof. A. E. Kennelly published a paper on "An Approximate Law of Fatigue in the Speeds of Racing Animals," noticed at length in NATURE, vol 75, p. 463. In this he showed that if L is the length of the race in metres, T the time occupied by the winner in seconds, and V the mean speed in metres per second, we have approximately

$$T = \frac{1}{c} L^{9/8} = \frac{c^8}{V^9},$$

whatever the type of race. If log L is plotted against log T, for example, different types of race give parallel straight lines. Prof. Kennelly has now published a second paper, "Changes during the Last Twenty Years in the World's Speed Records of Racing Animals"

(*Proc. Amer. Acad. Arts. Sci.* vol. 61, No. 11, 1926), in which the records created since the first paper was written have been included. Only two classes of events show an appreciable general increase in speed, men swimming by about 10 per cent., and horses running by about 2 per cent. In all other cases the new records fit reasonably well to the lines previously given. The records for horses, running or pacing, show as before far the best fit to the straight-line law, and bicycling records still form an apparent exception to the rule. The conclusion deduced that speed should be maintained at a uniform level throughout the race is in accord with the work of A. V. Hill.

DIAMAGNETIC GASES. Recently, E. Zehrer (*Zeit. für Phys.* vol. 37, p. 155, 1926), using an independent method, failed to confirm the experimental results obtained by Glaser, namely, that the specific susceptibilities of the diamagnetic gases hydrogen, nitrogen, and carbon dioxide were dependent on the pressure. It is therefore interesting to note that G. W. Hammar (*Proc. Nat. Acad. Sci.*, Oct. 1926), who employed the same method as Glaser, has found these susceptibilities to be independent of the pressure over a range from zero to one atmosphere. In searching for a possible source of error which might explain Glaser's results, Hammar found that a slight trace of moisture produced the effects described by Glaser, and he suggests that the difference between the two sets of results may be due to an adsorbed layer of water vapour on the surface of the test body. Hammar also directs attention to the need of greater reliability in the determination of the susceptibility of gases, since two of the latest and most careful determinations of the susceptibility of oxygen differ by 4·5 per cent., although each observer claims an accuracy of 0·1 per cent.

HEAT TREATMENT OF GAS CYLINDERS. -The second Report of the Gas Cylinders Research Committee, which has recently been issued, is concerned with the periodical annealing of cylinders. It was a recommendation of the Home Office Committee of 1895 that all cylinders of wrought iron or mild steel should be annealed every four years. On the other hand, the present Committee, in its first Report of 1921, considered that cylinders of 0·45 per cent. carbon steel should not require re-annealing during their life of fifteen to twenty years. The later experiments show that annealing, which is usually conducted at 650° C., and may be continued for many hours, is harmful. If the steel be overstrained and then annealed, the structure is altered, the ferrite and lamellar pearlite being replaced by ferrite with globular cementite, the size of the particles increasing with the time of annealing. This change is accompanied by a fall in the tensile strength and by an increase in brittleness, as shown by the Izod test. On the other hand, normalising, or heating to a temperature 50° above the critical point and then cooling in air without exposing to draughts, has no evil effects, and the injury done by overstraining followed by annealing may be almost completely corrected by such a treatment. The proper temperature is 900° for a 0·25 per cent. carbon steel and 850° when the carbon is 0·45 per cent. With properly made cylinders, a single normalising treatment after manufacture is all that is necessary. As it has been supposed that rough handling, involving jarring, may induce brittleness, experiments on the effect of repeated hammering have been made, with the result that the steel is not found to be rendered brittle by such treatment.

THE SUPPOSED REGENERATION OF ENZYME ACTIVITY. —During the past few years, various investigators have published experimental results which appear to indicate that certain enzyme solutions are able, after being boiled for some minutes, to recover partially their lost enzymic activity. Experiments made by Prof. Ivo Novi, and described in the *Rendiconti della R. Accademia delle Scienze dell' Istituto di Bologna* (Vol. 29), help to prove, as was shown by Pasteur more than sixty years ago, that such phenomena are not observed when care is taken to prevent access of air borne micro-organisms to the solutions.

HEATS OF CRYSTALLISATION. --The heats of crystallisation, Q, of seven more members of the homologous series of normal monobasic fatty acids, obtained by W. E. Garner, F. C. Madden, and J. E. Rushbrooke, are to be found in the September issue of the *Journal of the Chemical Society*. With the exception of stearic acid, the data for all the even acids up to C_{20}, and all the odd acids except three, are now available. As the series of acids is ascended, marked alternation in the values of Q is shown, and this is ascribed to an alternation in the arrangement of the terminal groups in passing from one acid to the next. An alternation in the melting-points of both odd and even members exists, and the two melting-point curves converge and approach a maximum at 115°. No evidence of alternation was obtained for the specific heats of the acids in the liquid state.

RADIATION THEORY OF CHEMICAL ACTION. —In a memoir published in the *Rendiconto dell' Accademia delle Scienze Fisiche e Mathematiche della Società Reale di Napoli*, Fascicoli 4-8, April-August 1926, Prof. Francesco Giordani proposes a modification of the formula connecting reaction velocity, k, with radiation density, u_ν, proposed by Lewis:

$$k = \frac{\pi e^2}{3mh\nu} u_\nu N.$$

He supposes that it is necessary to take into account the number of vibrations in the molecule r, which he puts equal to the number of ordinary chemical valencies concerned in the reaction, and instead of u_ν he uses $u_\nu^{1/r}$. When the modified Planck expression for u_ν is substituted in the equation, raised to the power $1/r$, it is shown that the results are in fair agreement with experiments on the decomposition by heat of phosphine, nitrogen pentoxide, and ozone (bimolecular). The great deviations between calculation and experiment which have previously appeared are then avoided.

THE DETERMINATION OF γ BY THE METHOD OF CLEMENT AND DESORMES.- The determination of the ratio of the specific heats of a gas by Clement and Desormes' method may be made to depend on measurements of temperature and pressure differences resulting from an adiabatic expansion or contraction (Lummer and Pringsheim, Partington, etc.) The adiabatic change is obtained by momentarily connecting the gas, contained in a vessel under a slightly different pressure, with the atmosphere. It has been known to all previous workers that equilibrium is not established instantaneously, but in a time which depends on the shape and size of the orifice, the volume of the vessel and the pressure difference. In the *Proceedings of the Indian Association for the Cultivation of Science*, for August 15, 1926, G. Subrahmaniam and G. Gunnayia show how to calculate approximately the time necessary for the pressures to equalise, in terms of quantities found in the experiments. Their results indicate that the size of the aperture does not have any great effect when the temperature measurements are employed to calculate γ, but when the pressures are measured, overshooting takes place if the opening is too large. In fixing the lower limit for the size of the aperture the effect of radiation has to be considered.

The Nutrition of Cattle.

IN a previous article in our columns (NATURE, 1925, vol. 116, p. 175) an account was given of some aspects of the feeding of cattle, including the method of indirect calorimetry, by means of which the value of different foodstuffs for maintenance and production can be determined, opportunity being taken at the same time to consider the relationship between the protein of the diet and the milk. The values assigned to different foodstuffs in nutrition depend not only on the accuracy of the experimental data from which they are estimated, but also on the correctness of the principles of the method of calculation used; that finality has not been reached in either case appears from a number of papers which have recently been published dealing with the various methods and their difficulties, both of technique and of interpretation. Probably the most important general figure for a foodstuff is its net energy value, that is, the amount of energy contained in it which is available for maintenance and production after deducting the non-utilisable energy and that necessarily expended in the actual processes of utilisation of the remainder.

The net energy value can be determined *directly* by means of the animal calorimeter The heat given off by the animal is deducted from the energy value of the food as determined in the bomb calorimeter, the difference giving that available for the maintenance or increase of body weight, and for the production of milk. The method requires the use of complicated apparatus and a great attention to detail: to ensure accuracy, a number of corrections must be applied to the experimental results (M. Kriss, *Jour. Agric. Res.*, 1925, vol 30, p. 404), but with proper precautions the heat production can be satisfactorily estimated to within 1 per cent.

On the other hand, this estimation can be made *indirectly*, either by the use of the animal calorimeter again, but determining the oxygen consumption and the carbon dioxide production (instead of the heat emission) and calculating the latter from the amounts of protein, fat, and carbohydrate oxidised in the body, as determined from the respiratory exchange and the respiratory quotient, or, more simply, by deducting from the energy of the food the energy of the excreta plus that of the body tissue gained as determined from the nitrogen and carbon balances. This latter method is the one more generally used and gives results which compare well with the direct method (M. Kriss, *loc. cit.*, p. 393): its most serious source of error appears to be the loss of material, from the urine and fæces, presumably through fermentation, during drying, preliminary to the determination of the energy value of the excreta in the bomb calorimeter: this loss can be minimised by drying at a low temperature.

In using the second of the two indirect methods described above, the 'balance' method, a source of error may be introduced by irregularity of excretion; thus the fæces of a given period may not correspond accurately to that period, and this is especially the case when the diet is varied. R. W. Swift (*Journ. Dairy Science*, 1925, vol 8, p 270) has made a study of the weights of fæces in metabolism experiments of varying length with cows and bullocks, and has found that the chances are 31 to 1 that, with an eight-day collection period, the errors of the averages will not exceed 7 per cent. and 5 per cent. respectively: it is probably better to ignore the first few days on a new ration: hence the entire period should last about a week.

If an animal neither loses nor gains weight over an experimental period, the heat production will equal the available energy of the food: but only rarely does this occur; usually the calculated energy of the flesh and fat formed or lost from the body must be subtracted from or added to the energy of the ration, to give the maintenance requirement. It is possible to avoid the calculation of the energy of the body tissue gained or lost by feeding the animal on two differing sub-maintenance rations, and calculating from the lessened loss of energy from the body on the higher ration, the increased amount of energy which must still be added to the latter to prevent any loss from the body; at the same time an estimation can be made for the heat production of the body when no food whatever is given. By increasing the diet above a maintenance value it is possible to obtain a figure for the amount of food which must be added for each pound of body fat laid on, an extremely important calculation for the fattening of animals.

Two assumptions are made in these calculations, which have been used chiefly by Armsby and Kellner respectively, as is pointed out by J. Wilson (*Scient. Proc. Roy. Dublin Soc.*, 1925, vol. 18, pp. 77 and 117): first, that the maintenance requirement is the same whether food is being taken or not, or whether the ration is large or small, and secondly, that the maintenance requirement found with one type of food applies equally if the nature of the ration be changed, provided it has an equal calorific value. Wilson has made a critical examination of some of Kellner's and Armsby's results, from which he concludes that straw, for example, is less efficient than hay, as a ration, and that the food required by the bullock, whether idle or fattening, rises with the amount and kind of long fodder in the ration and also with the rate at which fat is being put on. Thus the maintenance requirement rises with an increase in the ration; in part this is due to the ensuing stimulation of metabolism which always occurs after food, so that the body lives less economically and a proportion of the energy of the food is wasted as useless heat. The increased heat production after a meal, especially one containing protein, is a well-known phenomenon. It is thus difficult to apply results obtained with one kind of food to an experiment in which another ration is given, or to assume that the energy value of a food will be the same at whatever level it is fed. Accurate results will be obtained only when the ration given is just sufficient for maintenance.

The force of these criticisms, however, is somewhat reduced by improvements in the methods of calculating results, including the adjustment of the daily heat production to a figure representing a standard day of twelve hours lying and twelve hours standing, as well as by improvements in technique. The latest method of calculation of the net energy values of feeding stuffs and some of the results obtained are given in a series of papers from the Institute of Animal Nutrition, Pennsylvania State College (M. Kriss, *Jour. Agric. Res.*, 1925, vol. 31, p. 469; E. B. Forbes and M. Kriss, *ibid.*, p. 1083; E. B. Forbes, J. A. Fries, and W. W. Braman, *ibid.*, p 987; D. C. Cochrane, J. A. Fries, and W. W. Braman, *ibid.*, p. 1055; E. B. Forbes, *Proc. Am. Soc. Animal Production*, 1924, p. 23, and *Science*, 1926, vol. 63, p. 311, and E B Forbes, J A. Fries, and M. Kriss, *Jour. Dairy Science*, 1926, vol. 9, p. 15). The animal is given different rations during a series of experimental periods: by subtracting the heat production of a period on a lower diet from that of one on a higher ration, the increased heat production due to the increase in the food is obtained. The net energy required for maintenance is the total heat production

in the period minus the total increase in this value due to the food, calculated from the average of the figures previously obtained. The total net energy of the ration is the *average* net energy for maintenance as found in the different experimental periods in which the particular food under consideration was used, plus the energy gained by the animal, which is determined by subtracting the total heat production from the metabolisable energy of the food.

By this method it is found that the results obtained in the different experimental periods usually agree fairly well, and it is easy to see and discard any abnormal set of figures. The authors are inclined to consider differences in maintenance requirements in different periods as due to experimental errors rather than to differences in the rations or in the plane of nutrition of the animal. On the other hand, from experiments on fasting animals it appears that energy is more efficiently utilised in sub-maintenance periods, so that consistent figures for net energy values of rations are more likely to be obtained when the plane of nutrition in the different periods does not vary too greatly, and thus that the results should be considered as applying accurately in other cases only when the animals are kept at a somewhat similar level of nutrition. A further point to which attention may be directed is the applicability of results obtained with a particular breed to animals of another breed or in a different country where the rations are almost certain to be different. F. J. Warth, L. Singh, and S. M. Husain (*Memoirs Dep. Agric. India*, 1926, vol. 8, p. 153) have established certain differences between their animals and those used in America in considering the requirements for milk production with Indian foodstuffs. These differences affect primarily the digestibility of the rations, due in part to their actual nature, but at the same time individual animals have their own characteristics.

In conclusion, it may be stated with confidence that there appears to be sufficient accurate knowledge of the efficiency of different rations for maintenance and production to enable the practical farmer to select from those available to him the most economical in meeting his requirements.

Marine Biology at Plymouth.

THE latest number of the *Journal of the Marine Biological Association* (N.S., vol. 14, No. 2, August 1926, 10s. net) is full of good things. Dr. Orton resumes the interrupted publication of his studies on the rate of growth of marine organisms with a paper on the cockle. The investigations were carried out mainly in an experimental box laid down in the estuary of the river Yealm, in which the growing cockles were exposed to practically natural conditions, and the results have been checked by observations on near-by cockle beds. Apart from the definite determination of growth-rate—a matter of some economic importance, though it may be expected that the growth-rate will vary in different localities—the main interest of the paper lies in the study of the growth rings on the shell. It appears that, in the main, the deeply marked rings do indicate the winter checks in growth, and may be used with caution to determine the age of the cockle. Dr. Orton has, however, made the interesting observation that the mere removal of the cockles from the box for an hour so for the purpose of examination suffices to cause the appearance of a "disturbance ring" on the shell. Specially well defined rings are induced by the technique adopted of marking the shells for identification purposes with a file. Such disturbance rings can also be induced in the mussel. Further, in mild winters the winter ring may become extended and spread out into several rings, so that accurate determination of the age by means of winter-rings is a matter of some difficulty, especially in the larger individuals. The paper would have been improved by the addition of a summary.

A second paper by Dr. Orton deals with the comparative effect of dilute but lethal solutions of T.N.T. on native and Portuguese oysters (*Ostrea edulis* and *Gryphea angulata*), and was carried out at the request of the Fisheries Department to clear up a point left undetermined in the course of Dr. Orton's elaborate study of the abnormal mortality among native oysters in 1920-21. It is said that the mortality did not affect the Portuguese oysters. Dr. Orton shows, however, that both species are about equally susceptible to T.N.T.

The next paper—a valuable study, by Dr. C. M. Yonge, of feeding and digestion in the oyster—also arises out of Dr. Orton's oyster-mortality investigations, and its genesis illustrates in a striking way how important it is that 'fundamental' or purely scientific studies should accompany, or better still precede, any investigations directed towards a practical or economic end. It became apparent from Dr. Orton's own work on the mortality of oysters that not nearly enough was known about the normal physiology of the oyster for any one to say what conditions were normal and what were indicative of disease or pathological disturbance. Dr. Orton wisely pointed the moral by recommending a special research into the anatomy and physiology of the oyster, and of this Dr. Yonge's paper gives us the first fruits.

The paper seems to us wholly admirable. Dr. Yonge is of the modern school in combining anatomy with physiology, in studying form and function together. Considerable space is given to a clear and well-illustrated account of the anatomy and histology of the digestive apparatus both in the adult and in the larval oyster, and to a description of the amazingly complex system of ciliary currents by which the oyster collects and sifts out the tiny planktonic organisms on which it feeds, rejecting all such as are too large for it to deal with, and leading the rest over the palps into the mouth, down into the stomach and the digestive diverticula (commonly known as the 'liver'). Other sections treat of assimilation, the digestive enzymes, the function of the crystalline style, and the storing of reserve products. Dr. Yonge finds that digestion is mainly intracellular—soluble matter and fine particles being ingested by the cells of the digestive diverticula, larger particles by the phagocytes present in all parts. This is demonstrated by ingenious feeding experiments with iron saccharate, with blood corpuscles of the dog-fish, with olive oil, and with the diatom Nitzschia. He rejects the theory of the Danish workers that the oyster is primarily a detritus feeder, and emphasises the importance of the smaller diatoms, peridinians, algal spores, and other microscopic vegetable matter.

It comes out clearly from Dr. Yonge's work, especially that on the enzymes present, that the oyster, like other lamellibranchs, is specially adapted for the digestion, assimilation and storage of carbohydrates. The rationale of fattening the oyster for market is, then, to supply it with plenty of microscopic vegetable food, as already indicated by Savage in a recent paper, and as realised empirically in some fattening ponds, particularly in France. It has been known for some time that the oyster stores its surplus nourishment mainly in the form of glycogen, which is no doubt

chiefly derived from the carbohydrates richly present in the diatoms and peridinians of its food. Dr. Yonge's elaborate paper represents a distinct advance in our knowledge of lamellibranch physiology, and cannot fail to be of great service both theoretically and practically.

The three papers so far considered take up about half the present number of the *Journal*, and the remaining papers can be only lightly touched upon. Mr. F. S. Russell continues his interesting studies on the vertical distribution of the macro-plankton, with papers on the diurnal changes in distribution of pelagic young fish and on the importance of light as a factor in determining the vertical distribution of plankton forms. From Dr. Atkins comes a third contribution to our knowledge of the phosphate content of sea-water in relation to the growth of algal plankton. Samples obtained from the English Channel, North Sea, the open Atlantic and Pacific confirm the author's views on the importance of phosphate as a limiting condition for production in the sea. Mr. C. F. Hickling gives some further details regarding the remarkable kind of luminescence discovered by him in the fish *Malacocephalus laevis*. Among two or three faunistic papers one may perhaps specially note one by Dr. Lebour giving a general survey of larval euphausiids, with a scheme for their identification. Such work is of very great service to plankton investigators, and it is to be hoped that Dr. Lebour will continue the good work and deal with other groups in the same way.

In conclusion, mention must be made of the ingenious 'vacuum grab' invented by Mr. O. D. Hunt, with the assistance of Dr. Bidder, and here described in detail. By means of this instrument samples of the bottom can be taken which retain the finest particles together with the micro fauna and microflora therein contained. E. S. R.

University and Educational Intelligence.

BIRMINGHAM.—At the meeting of the Council of the University held on November 3 the following appointments were made: Dr T. L. Hardy, assistant physician to the General Hospital, to be assistant to the chair of medicine; Dr. C. C. W. Maguire, physician for out-patients at Queen's Hospital, to be honorary demonstrator in the Department of Anatomy.

It was decided that the Court be asked to confer the title of emeritus professor upon Prof. O. J. Kauffmann, joint professor of medicine in the University from 1913 to 1926.

CAMBRIDGE.—Mr. T. W. Wormell, St John's College, has been appointed observer in meteorological physics at the Solar Physics Observatory. Mr. J. T. MacCurdy, University lecturer in psycho-pathology, and Mr H. C. B. Mynors, have been elected to fellowships at Corpus Christi College. The Adam Smith Prize has been awarded to G. T. Jones, Emmanuel College. The Engineering Department has been presented with portraits of Sir Alfred Ewing, the late Prof. Bertram Hopkinson and Prof. Inglis. The Henry Sidgwick Memorial lecture will be given at Newnham College on Nov. 13 at 5 P.M., by Sir William Bragg, who will take as his subject "The New Crystallography."

LONDON.—The following doctorates have been conferred: *D.Sc.* (*Economics*) on Mr. S. G. Panandikar (London School of Economics) for a thesis entitled "The Wealth and Welfare of the Bengal Delta"; *D.Sc.* (*Chemistry*) on Mr. G. W. Ellis for a thesis entitled "A Contribution to the Chemistry of Drying Oils, Parts i-iii. (containing a Study of the Autoxidation of Linseed Oil and a Theory on the Nature of the Autoxidation of Unsaturated Compounds)"; *D.Sc.* (*Veterinary Science*) on Mr. J. T. Edwards for a thesis entitled "The Chemotherapy of Surra (*Trypanosoma evansi* infections) of Horses and Cattle in India."

ST. ANDREWS.—On November 3 Dr. Fridtjof Nansen was installed as Rector of the University, after having been admitted to the honorary degree of Doctor of Laws. He delivered an inspiring address on the spirit of adventure, in the course of which he referred to his own experiences as an explorer and as a supporter of the League of Nations. The honorary degree of LL.D. was then conferred upon His Excellency Mons. P. B. Vogt, Norwegian Minister; Prof. Vilhelm F. K. Bjerknes, of the University of Oslo; Prof. Bjorn Helland-Hansen, of Bergen; Capt. Otto Neumann Sverdrup (Captain of the *Fram*); Prof. J. Norman Collie; Brig.-General the Hon. Charles Granville Bruce; Sir T. W. Edgeworth David; and (*in absentia*) the Right Hon. Viscount Cecil of Chelwood.

IT is stated in the *Chemiker Zeitung* that Dr. G. von Hevesy, professor of physical chemistry at the University of Freiburg in Baden, has been invited to succeed Prof. Bodenstein in the chair of physical chemistry at the Technische Hochschule at Hannover.

THE British Institute of Adult Education issued in September the first number of a half-yearly review entitled the *Journal of Adult Education*, published by Messrs. Constable and Co., Ltd., at 2s. 6d. The editors, Prof. J. Dover Wilson and Prof. A. E. Heath, are assisted by an advisory panel of thirty-one, whose names, well known in educational circles, appear on the cover. This first number is remarkable for the prominence given to the questions of what are and what should be the purposes of adult education. The questions are raised both explicitly in the more important articles, and indirectly by incompatibility of the ideals of some of the writers. They are dealt with most comprehensively by Prof. Robert Peers, the director of the important department of extra-mural education of University College, Nottingham, who classifies the various views concerning the aims of adult education under the three heads—development of the individual person, social service, and social change. A certain ambiguity is observable in the arguments owing to confusion between the aims of the students, the aims of the teachers, and the aims of those who organise and administer and finance the work. Education that aims primarily—not at the student's emancipation from the shackles of ignorance, but at the emancipation of 'workers' from the restraints incidental to a social system under which 'the means of life' are subjects of private ownership, the education on a Marxian basis, as given in the 'Labour' colleges, is described in one of the articles as 'independent' working-class education. This article, beginning with this curious use of the word 'independent' and ending with an appeal to class hatred by describing resistance to the subsidising of the mining industry as "the whole power of capitalism turned to defeating one particular section [of 'the workers'] by the use of the starvation weapon against women and children," shows that a wide circulation of the Journal is anticipated.

A PROJECT for founding a British Institute in Paris was launched at a meeting at the Mansion House,

8 in. long and 0·25 in. in diameter have been prepared by lowering a graphite tube full of the molten metal slowly through an electric tube furnace, so that freezing proceeds from the bottom upwards. The position of the crystal axes was determined by means of X-rays, and the rods extended in a tensile testing machine. The crystal axis of the specimen moved in the same direction as in aluminium during extension. As these metals have the same crystal structure as aluminium, it was concluded that distortion was similar in every case, and that gold, silver and copper crystals distort by slipping on a (111) plane in a (110) direction. The crystals all harden during the process of deformation, but when the shear stress is plotted against the extension, the form of the curves is different for each metal.

R. E. **Gibbs**: The polymorphism of silicon dioxide and the structure of tridymite. The structure of tridymite was similar to that of ice, *i.e.* D_{6h}^{4}, with four molecules per cell, in which $a=5·03$ and $c=8·02$. The framework can be considered as a close-packed arrangement of oxygen atoms of diameter about 2·6, whilst the silicon atoms occupy the spaces between four neighbouring oxygens. It is probable that the structures are ionic in nature, being variations of a two-to-one packing of oppositely charged ions. Possible modes of β-β transitions lead to the idea that these sluggish changes are characterised by a change of partners between neighbouring ions. On other hand, the α-β transition, at least in the case of quartz, is merely a small atomic rearrangement not sufficiently drastic to involve a change of neighbours. The α-states are probably created by distortions of the β-forms involving lower symmetry and possibly larger cells. α-tridymite is orthorhombic, having a cell $a=9·9$, $b=17·1$, $c=16·3$, in which the units must be polymerised groups $nSiO_2$, where n is larger than two and probably equal to eight. The existence of a third form α' of tridymite resembling the ordinary α-form was confirmed.

Twenty six papers were read by title only.

Royal Microscopical Society, October 20.—A. **Piney**: A method of silver impregnation of Zenker-fixed sections. The method is only a modification of Bielchowsky's technique and is designed to apply to tissues fixed in mercuric chloride solutions. The essential point is the removal of all traces of the mercuric salt, followed by removal of the iodine, which was employed for this purpose. The wax is removed from the section with xylol, and the section is then placed in 0·4 per cent. iodine in 80 per cent. spirit for 10 minutes. Some of the iodine is removed by soaking the section for 30 minutes in 70 per cent. alcohol, but the remainder is got rid of by immersion in 0·25 per cent. sodium thiosulphate dissolved in 50 per cent. alcohol (not in water as recommended by Heidenhain). The section is now washed in water for an hour, and then immersed in 0·25 per cent. potassium permanganate in water, swilled in distilled water, placed in 5 per cent. aqueous oxalic acid for 20 minutes, washed for 2 hours in running water, and then stained by the Bielchowsky method. Toning with 1 per cent. gold chloride and fixation with 5 per cent. hypo are an advantage, as is also counterstaining with Weigert's iron hæmatoxylin and van Gieson's solution. The method is particularly adapted for the demonstration of reticular fibrils in hæmatopoietic tissues.

PARIS.

Academy of Sciences, October 11.—V. **Grignard** and P. **Muret**: Pyrosulphuryl chloride. In the production of this substance by the reaction between sulphur trioxide and carbon tetrachloride there are difficulties in purification. Utilising the reaction between carbon tetrachloride and chlorsulphonic acid, the conditions have been studied with the view of obtaining a purer product. The decomposition resulting from rise of temperature has also been studied.—Henri **Jumelle**: New observations on tombak tobacco. The identification of the species is complicated by the fact that there are several tombak tobaccos. One tobacco sold under that name has proved to be *Nicotiana rustica*. It contains a high proportion of nicotine (6-12 per cent.) and may be of service as a source of nicotine for viticultural or horticultural purposes.—T. **Rado**: The calculation of the area of curved surfaces.—Paul **Flamant**: The continuity of the distributive transmutations and the extension of a transmutation defined for polynomials.—Paul **Dumanois**: The importance of the combustion yield in internal combustion engines. According to the theory of combustion and detonation developed by the author in previous communications, a mixture of petrol and methyl alcohol should give a higher efficiency than petrol alone. Experimental proof of this is now given: the fuel used contained 70 per cent. of methyl alcohol and gave an increase of 15 per cent. in efficiency over pure petrol.—Th. de **Donder**: The application of the quantification deduced from the Einsteinian gravific.—L. **Meunier** and G. **Rey**: The action of ultraviolet light upon wool. Under the action of sunlight or the mercury vapour lamp, the condition of the sulphur in the wool is changed; part is converted into sulphur dioxide, which is partially oxidised to sulphuric acid. These changes can be followed by an indicator such as methyl red. Reactions of the insolated wool with nitroprusside, quinone, alloxan and ninhydrin are also described.—W. J. **Richards**: The effect of α-rays on supersaturated solutions. It might be expected that α-particles would produce crystallisation in supersaturated solutions. Negative results were obtained with solutions in water of sodium sulphate, potassium sulphate, calcium chromate and lithium carbonate. Negative results were also obtained with aqueous sugar solutions and with fused salol.—Louis **Grenet**: The limiting states of alloys.—M. **Ballay**: The Ludwig-Soret phenomenon in alloys. The concentration changes produced in solutions unequally heated are shown experimentally to exist in alloys, and this phenomenon must be taken into account in a general discussion of the phenomena of segregation.—V. **Hasenfratz** and R. **Sutra**: Some derivatives of harmalol and harmol.—Marcel **Frère-jacque**: Vaillantite, an agent of sulphomethylation. Formation of a new active camphorsulphonic acid.—H. **Prophète**: Contribution to the study of the wax of flowers: rose wax. Study of its unsaponifiable matter.—Germain **Chalaud**: The first phase of the evolution of the gametophyte of *Fossombronia pusilla*.—Jean Jacques **Trillat**: The action of X-rays of long wave-length on micro-organisms. The case of *B. prodigiosus*. These researches showed the bactericidal influence of primary X-rays of long wave-length.—Auguste **Lumière** and Félix **Perrin**: A new class of hypnotics. The dialkylphenylacetamides. Dipropyl-, propylallyl-, and diallylphenylacetamide have been prepared and possess hypnotic properties, but the ratio of their active dose to the toxic dose is rather high.—**Javillier** and H. **Allaire**: Phosphorus ratios in the tissues.

ROME.

Royal National Academy of the Lincei: Communications received during the holidays.—G. **Fubini**: The theory of R surfaces and their transformations.—

Giorgio Dal **Piaz**: The discovery of a supposed vein of post-glacial volcanic rock in the neighbourhood of Bressanone (Upper Adige).—Giuseppe **Corbellini**: A class of variety characterised by means of parallelism.—V. **Hlavatý**: Local parameters in a Riemann variety.—J. **Soula**: Functions defined by Dirichlet's series.—Oscar **Zariski**: The development of an algebraic function in a circle containing several critical points.—Filippo **Burzio**: Order of magnitude of quantities relative to the second ballistic problem. A formula for ballistic nutation.—A. **Weinstein**: Liquid jets with given walls.—Bruto **Caldonazzo**: An extension of Bernoulli's theorem. This theorem, which is valid for the stationary motion of a perfect fluid, is extended to meet certain cases of variable motion.—Mentore **Maggini**: Interferometric measurements on the four large satellites of Jupiter. Observations on the changes of figure and on the axial inclinations of these satellites are described.—Vasco **Ronchi**: Further concerning "flying shadows." D'Arturo's criticisms of the author's conclusions are refuted.—Franco **Rasetti**: The Doppler effect in sensitised fluorescence.—G. **Wataghin**: The ballistic hypothesis and the Doppler effect. The two treatments as yet known of the Doppler effect both lead to results unfavourable to the ballistic theory of this effect.—G. **Natta** and F. **Schmid**: Oxides and hydroxides of cobalt (ii). The crystalline structure of the saline oxide of cobalt. The oxide Co_3O_4 crystallises in the monometric system and is isomorphous with magnetite. The size of the elementary cell of the crystalline lattice, which is of the spinel type, is 8·02 A.U. and contains eight molecules. The density is calculated to be 6·21, which lies among the somewhat discordant experimental values.—E. **Repossi** and V. **Gennaro**: The minerals of the serpentine of Piossasco (Piedmont). The mineral species so far identified in this serpentine are ilmenite, magnetite, calcite, aragonite, diopside, granite, vesuvianite, chlorite, titanite, perowskite, apatite, and, probably gavite.—Sabato **Visco**: The behaviour of the hepatic glycogen in fasting animals treated with insulin. The administration of insulin to fasting rabbits diminishes the loss in weight. The liver and spleen increase in weight, whereas the heart, kidneys, suprarenal capsules and lungs show slight and variable changes in weight. The amount of glycogen in the liver is increased very considerably by treating the fasting animal with insulin.

SYDNEY.

Linnean Society of New South Wales, August 25.—C. H. **Anderson**: A revision of certain Australian Rhenopodiaceæ. The paper embodies a critical examination of the two species, *Bassia tricornis* (Benth.) F.v.M. and *Bassia enchylænoides* F.v.M. A new genus is proposed to take in one of the species, and the other is transferred to the genus Kochia.—E. **Cheel**: Notes on *Melaleuca pubescens* Schauer and *M. Preissiana* Schauer. The author's view is that *M. pubescens* Schauer has priority, that the Victorian plants are merely forms of *M. pubescens*, and that the Western Australian plants known as "Ironwood" are glabrous forms of the same species.—Rev. H. M. R. **Rupp**: Description of a new species of Diuris from Barrington Tops, N.S.W. The species described as new is closest to *D. spathulata*, from which it differs in its venation, more prominent lateral lobes of the labellum, and in its short and thick column.—A. M. **Lea**: On some Australian Curculionidæ. The paper contains descriptions of two new genera and sixty-five new species, one of which belongs to Rhinomacer, a genus now first recorded as Australian.

Official Publications Received.

BRITISH AND COLONIAL.

Aeronautical Research Committee: Reports and Memoranda, No. 1019 (Ae. 220): Note on a Hot-Wire Speed and Direction Meter. By L. F. G. Simmons and A. Bailey. (C. r. Accessories, Instruments, 90.—T. 2033.) Pp. 7+7 plates. 9*d.* net. No. 1027 (Ae. 225): Test of Two Aerofoils, R.A.F. 27 and R.A.F. 28. By A. S. Hartshorn and H. Davies. (A. 3. a. Aerofoils-General, 104.—T. 2257.) Pp. 10+6 plates. 9*d.* net. No. 1038 (M. 47): Report on the Accelerated Ageing of 'Y' Alloy. By S. L. Archbutt and J. D. Grogan. (B. 1. a. Metals, 55.—T. 2251.) Pp. 10+4 plates. 9*d.* net. (London: H.M. Stationery Office.)

South Australia. Department of Mines: Geological Survey of South Australia. Bulletin No. 12: Clay and Cement in South Australia. By R. Lockhart Jack. Pp. 120+4 plates. (Adelaide: R. E. E. Rogers.)

Annual Report for the Year 1925 of the South African Institute for Medical Research, Johannesburg. Pp. 37+2 plates. (Johannesburg.)

Development Commission. Sixteenth Report of the Development Commissioners for the Year ended the 31st March 1926. Pp. 157. (London: H.M. Stationery Office.) 3*s.* net.

Our Heritage—The Empire: a Report on some Aspects of a Tour of the King's Overseas Dominions undertaken chiefly in the Interests of Empire Migration and Settlement, 1925–1926. By Commissioner David C. Lamb. Pp. 40. (London: The Salvation Army.)

Report of the Progress of the Ordnance Survey for the Financial Year 1st April 1925, to 31st March 1926. Pp. 8+5 plates. (London: H.M. Stationery Office.) 3*s.* 6*d.* net.

Transactions of the Leicester Literary and Philosophical Society, together with the Council's Report and the Reports of the Sections, 1925–26. Vol. 27. Pp. 66. (Leicester.)

Smoke Abatement League of Great Britain. Seventh Report, covering the Nine Months October 1st, 1925, to June 30th, 1926. Pp. x+22. (Manchester.)

British Museum (Natural History). Picture Postcards. Set C17: British Sea Birds, Series No. 1, Gulls. 5 cards in colour. Set C18: British Sea Birds, Series No. 2, Auks and Cormorants. 5 cards in colour. (London: British Museum (Natural History).) 1*s.* each set.

FOREIGN.

Instituts scientifiques de Buitenzorg: "'s Lands Plantentuin." Treubia: recueil de travaux zoologiques, hydrobiologiques et océanographiques. Vol. 7, Livraison 3, Septembre. Pp. 217-330. 2.50 f. Vol. 8, Livraison 3-4, Juillet. Pp. 199-512. 5.00 f. (Buitenzorg: Archipel Drukkerij.)

CATALOGUES.

Microscopes and Accessories. Pp. 92. (London: C. Baker.)

Diary of Societies.

SATURDAY, NOVEMBER 13.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Rev. E. M. Walker: The Study of History (2).

PHYSIOLOGICAL SOCIETY (at the London School of Medicine for Women), at 4.—R. T. Grant: An Observation on the Function of the Pericardium.—A. Levin: Fatigue, Retention of Action Current and Recovery, in Nerves of the Spider Crab.—T. Lewis and H. M. Marvin: Herpes Zoster and Antidromic Impulses.—R. W. Gerard, Prof. A. V. Hill, and Y. Zotterman: Energy Liberation of Nerve as a Function of Frequency of Stimulation.—R. W. Gerard: The Two Phases of Nerve Heat Production.—M. Lowenfeld, S. T. Widdows, M. Bond, and E. Taylor: Variations in Composition of Early Human Milk and Factors Influencing Them.—D. Woodman, E. E. Hewer, and M. L. Keene: Time of Appearance of Digestive Enzymes in the Human Fœtus.—W. C. Cullis, D. Rendel, and E. Dahl: Points in the Technique of the Ethyl Iodide Method.—Demonstrations by A. Levin: An Improved Device for Time-marking and Similar Purposes.—E. E. Hewer and M. F. L. Keene: Pineal and Choroid Plexus in the Human Fœtus.—G. Briscoe: Records of Different Types of Respiratory Movements.

MONDAY, NOVEMBER 15.

ROYAL MEDICO-PSYCHOLOGICAL ASSOCIATION (at British Medical Association, Tavistock Square), at 4.—Dr. A. Adler: The Cause and Prevention of Neurosis.

ROYAL GEOGRAPHICAL SOCIETY (at Lowther Lodge), at 5.—J. A. Steers: The East Anglian Coast.

INSTITUTION OF ELECTRICAL ENGINEERS (Tees-Side Sub-Centre) (at Cleveland Technical Institute, Middlesbrough), at 7.—J. Rosen: Address.

INSTITUTION OF AUTOMOBILE ENGINEERS (Scottish Centre) (at Royal Technical College, Glasgow), at 7.30.—J. E. Southcombe: Recent Research on Friction and Lubrication.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—H. V. Lanchester: Bridges and Traffic.

ARISTOTELIAN SOCIETY (at University of London Club), at 8.—J. C. McKerrow: Evolution and Contingency.

ROYAL SOCIETY OF ARTS, at 8.—Prof. H. L. Callendar: Recent Experiments on the Properties of Steam and High Pressures (Howard Lectures) (1).

HUNTERIAN SOCIETY OF LONDON (in Cutlers' Hall, Warwick Lane, E.C.), at 8.45.—Sir Humphry Rolleston, Dr. G. Little, Dr. L. Williams, and others: Discussion on Medicine and the Press.

TUESDAY, NOVEMBER 16.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. G. W. C. Kaye: The Acoustics of Public Buildings (Tyndall Lectures) (3).

ROYAL STATISTICAL SOCIETY (at Royal Society of Arts), at 5.15.—Viscount D'Abernon: German Currency: The Collapse and Recovery, 1920–1926 (Inaugural Address).

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. G. D. Hale Carpenter: The Biology of *Glossina palpalis* in connexion with Sleeping Sickness.

Nor can the evidence accumulated elsewhere be said to be more convincing. The work mostly quoted in favour of the existence of 'teleplasm' is Dr. von Schrenck-Notzing's "Materialisationsphänomene," which gives several hundred photographs of this mysterious substance. This work was of sufficient importance to lead to the study of its author's medium by the S.P.R. and by a Committee of the University of Paris. The official reports of both these bodies pronounced the phenomena observed to be quite inconclusive. Another attempt made by an academic body, this time the University of Vienna, to corroborate such phenomena, led last year to an equally pronounced failure. Thus Crookes's failure to convince the Royal Society may be said to have been the precursor of a consistent series of similar failures.

The tragic case of the late Dr. W. J. Crawford, of Belfast, is instructive. Here was a university lecturer of some distinction whose leaning towards mysticism made him an easy victim of a family of artisans with alleged mediumistic faculties. He devoted four years to their examination and endeavoured to duplicate and surpass the records of Crookes and Schrenck-Notzing. The 'invisible operators' who ruled the procedure led him on step by step until his records became the very travesty of scientific method, and gross imposition was presented in terms of his own psycho-physical guesses and speculations. When his career ended in suicide and an attempt was made to repeat his results, the repetition, which duly occurred, only served to reveal the *modus operandi* of the 'circle,' which was anything but spiritual. Such a *dénouement* is not, of course, unknown in purely physical science. Blondlot's *N*-rays were the subject of some fifty scientific papers, and his 'discovery' was recognised by the award of a substantial prize by the Paris Academy of Sciences. It is only natural that the caution wisely displayed by many physicists with regard to *N*-rays should be doubled and trebled when certain phenomena long discredited are presented in a new guise even on apparently unimpeachable authority.

Sir William Crookes in 1874 walked about in a well-lighted room with what he believed to be a 'spirit' on his arm, a 'spirit' resembling a girl of eighteen. No such amazing privilege has been vouchsafed to any man of scientific eminence since then. The phenomena obtained by scientifically trained observers have been poor in comparison with that high-water mark. This may be due to their 'unsympathetic' attitude, or it may be due to a wider knowledge of the chances of error and the means of deception. Investigators in search of ectoplasm have to be content with what looks like skin-bags or lengths of chiffon. As the control becomes stricter the results become poorer. When the control becomes rigid the phenomena cease altogether. That is the general rule, and it admits of only one interpretation.

The demands made upon the scientific investigator are nowhere more severe than in the cases of 'spirit photography' and the 'direct voice.' As the spirit 'extras' are not visible to the ordinary observer, we must suppose that they do not reflect ordinary light and are to that extent immaterial. Spiritualists usually meet this argument by saying that the effect on the photographic plate is not produced by light of any known wave-length but is a direct action on the plate itself. We must, therefore, assume that the invisible or disembodied artist can draw a likeness of a deceased friend of the sitter on the plate in such a way as to produce a correct negative. The difficulty of this feat is greatly increased if we remember that clairvoyants claim to see these spirit friends hovering about the sitters in the very attitudes shown on the photographs. Rather than face the innumerable difficulties in the way of a consistent theory conforming to the spiritualist view, most investigators will prefer to regard all so-called spirit photographs as examples of the almost numberless methods of deception which may be, and have been, practised in this most elusive department of spiritualist activities.

In the case of the 'direct voice,' we are confronted with even more formidable difficulties. There is nothing more 'spiritual' or less 'material' about a voice than there is about a brick wall, though the unscientific person may think otherwise. Where exactly does the material nature or structure of the direct voice begin? Do the spirits produce the necessary air waves direct at some focus in the air? One spiritualist view often met with is that the 'spirits' materialise a larynx and sufficient in the way of lungs and mouth cavities to produce the sounds heard. This does not make the matter any clearer. It is much easier to assume deception, more especially as fraud in this case is easy and 'convincing' and control extremely difficult, owing to the lack of orientation shown by most human ears in the dark. Here again the *onus probandi* must weigh heavily on those who claim that there is positive evidence.

The difficulties placed in the path of the observer all tend to make control more difficult and deception easier. Modern mediums work in total darkness or the dimmest of red light. The observer is not allowed to prescribe conditions. So long ago as 1880, Mr. Stainton Moses, an eminent spiritualist, said: "In 99 cases out of 100, people do *not* get what they want or expect. Test after test, cunningly devised, on which the investigator has set his mind, is put aside, and another substituted." Mediums may, by the rules of

the game, fail as often as they like and substitute other tests of their own devising. The patience displayed by expert investigators during some of their test sittings is astonishing. Hour after hour will go by without anything happening. The medium will fall asleep and wake up again. When anything does happen, if only the production of a rubber film (or something resembling it) from the mouth of the medium, it is eagerly scrutinised and carefully recorded.

Nobody can complain of unwillingness on the part of scientific men to investigate any phenomena offering a chance of extending the boundaries of knowledge, and the rewards, both material and social, of any such extension are very great. But after half a century of growing disappointment with spiritualistic phenomena, the number of qualified volunteers naturally shows signs of diminution. On the other hand, the flood of charlatans and impostors increases day by day. The 'new revelation' imported from the United States in 1852, with its combination of 'supernormal' telegraphy with Pentecostal gifts and Delphic oracles, has obtained almost undisputed sway over the mind of the masses thirsting for signs and wonders and determined at any price to believe.

It is for science to stem the tide of superstition and sift the true from the false. We are quite justified in assuming, with Sir Oliver Lodge, that man's future outlook on the universe will be very different from the orthodoxy of 1926. Such an evolution is bound to take place even on purely physical grounds, as indeed is shown by the prodigious changes in physical conceptions since 1895. But the fundamental principles of the scientific method will not change, and no set of phenomena which depends for its occurrence, not upon ascertainable laws, but upon the whim of invisible operators not amenable to a court of law, can appropriately form part of the subject matter of natural science.

In spite of all failures and discouragements, it is highly desirable that a competent body should exist for making out a *prima facie* case in favour of any alleged new phenomena of the class we are discussing. Such a body we have in the Society for Psychical Research, which has admirably fulfilled its functions in spite of material limitations such as do not hamper the wealthy 'colleges' of spiritualism. This Society has already done good work by its study of telepathy, hallucinations, and duplex personality. It includes people of the most diverse views, and can be relied upon to welcome any evidence of really unknown phenomena. It might possibly be associated usefully with the recently formed National Laboratory of Psychical Research, which is equipped with the means of studying psychical and related phenomena, but that should be easily arranged if desired. In the present state of this matter it is wisest and best for official science to wait for the recommendation of such a society before devoting any attention or labour to alleged 'supernormal' occurrences. The very use of the word 'supernormal' instead of 'abnormal' suggests that these occurrences belong to an order raised above the normal order of the universe (which would, of course, remove them from the province of science). That there may be such a supernormal order of things no philosopher can *a priori* deny, but the use of the word is too unpleasantly suggestive of a hieratic domination now happily overcome to be palatable to scientific men, and they will hesitate before installing the 'medium' in the high place from which, after much fighting and suffering, they have driven his ecclesiastical predecessor.

Education, Science and Mr. H. G. Wells.

The World of William Clissold: a Novel at a New Angle. By H. G. Wells. Vol. 1. Book the First: *The Frame of the Picture;* Book the Second: *The Story of the Clissolds—My Father and the Flow of Things.* Pp. 245. 7s. 6d. net. Vol. 2. Book the Third: *The Story of the Clissolds—Essence of Dickon;* Book the Fourth: *The Story of the Clissolds—Tangle of Desires.* Pp. 247-601. 7s. 6d. net. Vol. 3. Book the Fifth: *The Story of the Clissolds—The Next Phase;* Book the Sixth: *The Story of the Clissolds—Venus as Evening Star;* The Epilogue: Note by Sir Richard Clissold. Pp. 603-885. 7s. 6d. net. (London: Ernest Benn, Ltd., 1926.)

ALTHOUGH the critics have not been stirred by volumes 1 and 2 of William Clissold's achievement, there should be wigs on the green over volume 3, if it be not above them. Book V. is masterly in many ways—the less said of VI. the better, perhaps. No writer, other than the author, could have preferred the indictment he does against our public-school system and the ancient universities.

The attempt is made, in a preface, to justify the contention that the book is a novel: there is no novel in it: true it is, the story is told, ostensibly, by one William Clissold or through his brother Dickon but William is himself again, as he ever will be: from beginning to end, we are dealing with autobiography and early in the recital the writer gives himself away in saying—"Autobiography, provided that it be not too severely disciplined may be an almost inexhaustible occupation. Nothing is altogether irrelevant. Whatever interests me or has ever interested me is material." This, in a few clear words, is the book. It is a medical treatise--largely on social pathology.

The author is a photographer, working with a lens stopped down to a low aperture but of no great depth

of focus, giving very clear pictures of superficial appearances. A photographer neither analyses nor constructs—he must record what is before him. However much he may fake his picture in development, out in the open he must take what is offered him by Nature and, at most, can await a favourable light and so play with the shadows.

At the moment there is what amounts to little short of a conspiracy to represent science and religion as moving along the same path. They never can, unless and until we make a religion of our knowledge and recognise that, therefore, religion must be imperfect and ever correcting and shifting its boundaries. Science is ultimately the search after truth. Who can say what religion is? For every one the word has a different meaning. Our William, be it remarked, is a little fuzzy in his high lights. He can't be satisfied with what he has and may have and then leave it to the other fellow to have his turn, but hankers for more. He is so spoilt by frequent reprinting, that he must contemplate a new edition of himself, no doubt with special binding:

"To me it is far easier to suppose that this present unfolding of consciousness and will is only a birth and a beginning and that I am not merely myself but a participator in a Being that has been born but need not die."

Surely, he is here but seconding a vote of thanks to "that chap Oliver Lodge." Still, "belief in a living personal God—slight vestiges": we all have more or less as an ineradicable inheritance from primitive man.

The lapse into such anthropomorphism is proof how difficult it is for intelligence to prevail over convictions forced upon youth. The great problem before us soon in schools will be—how far we are entitled to go in retarding and repressing mental growth by forcing an 'established faith,' without explanation or qualification, upon children: whether parent and especially teacher be justified in misleading by baldly repeating assertions which have no authority other than tradition. The struggle is between knowledge and ignorance. Our William defines the position clearly and boldly:

"I do not know how Protestantism will end. But I think it will end. I think it will come to perfectly plain speaking and if it comes to perfectly plain speaking it will cease to be Christianity. There is now little left of the Orthodox Church except as a method of partisanship in the Balkans. The League of Nations may some day supersede that and then the only Christianity remaining upon earth will be the trained and safeguarded Roman Catholic Church. That is less penetrable, a world within a world, it shields scores of millions securely throughout their lives from the least glimpse of our modern vision."

Teachers of science, and examiners, are equally concerned. Over and over again, when advocating *the teaching of scientific method*, I have been told by my friends—"You must teach something definite: students ask for assurance and will not countenance any philosophic doubt": examiners, too, ask for positive answers. Tennyson's lines are not yet accepted even of science:

> There lives more faith in honest doubt,
> Believe me, than in half the creeds.

The attitude of all the schools is not merely unscientific but is one tending to systematise untruthfulness. Our William, at least, can think of better times:

"I can discover in all my world nothing enduring, neither in the hills nor in the sea, nor in laws and customs nor in the nature of man, nothing steadfast except for this—a certain growth of science, a certain increase of understanding, a certain accumulation of power. But there is that growth of science, there is that increase of understanding, there is that accumulation of power. I do not know why it should be so but so it is. It gathered its force slowly before man was. It goes on now with accumulating speed and widening scope and on it I build my working conception of the course of life. Man, unconscious at first, begins now, in an individual here and an individual there, to realise his possibilities and dream of the greatness of his destiny. A new phase of history is near its beginning. But it has not begun. Such science as we have brings us suggestions rather than direction."

William Clissold is not all religion, though considered under the conventional classification of *Wein, Weib* and *Gesang*, it has a limited range of subject. Wine is only once referred to—a single bottle of Château Margaux 1917, not a great vintage, produced at lunch by Sir Rupert Yorke. Still, this suffices to incite William's reflections upon Sir Rupert's sexual and religious outlook. It appears also to have led him to refrain from referring to certain questions he had intended to raise—the projected exchange of opinion would have been "as possible as with a pensive lion in the zoo." Pity it is perhaps that he has not met with more pensive lions in the course of his career and has not thereby been forced to concentrate upon some definite line of action.

After an over-full dose of *Weib*, we get music in the form of a study of futurism. Our William's swansong foreshadows a metamorphosis of mankind—new ways of living—one terrestrial anthill: this he regards as the necessary, the only possible, continuation of human history. He contemplates the organisation of a central police bureau to co-ordinate the protection of life, property and freedom throughout the world, without distinction of persons under an universally accepted code. In fact, the lions and lambs are all to lie down comfortably together. The coal strike was only begun when the book was issued. The history of Ireland, the

love lost between the States of Europe, the growing development during many years past of local self-government in Great Britain—such items are left out of account.

The men of large material influence are to reconstruct the world upon broader, happier and finer lines. Their first struggle is to be with the Press. Civilisation must be by newspapers. Open, candid, full and generous, these are the qualities the newspaper of the new life must possess. It must suppress nothing. It must bring to every mind capable of receiving it the new achievement of human and organising power, the victories of conscious change. The daily papers of educated people half a century ahead may be a tenth of the size and ten times the price of the present "wildly flapping caricatures of contemporary happenings." The Press apparently is to be the work of the men of affairs. Our William says, quite truly, the daily paper is a daily disappointment—but to how many? He has found but one newspaper that comforts his soul and that is NATURE, to which flattering reference is made. "Domestic bye-products," such as sons, will have to justify their sonship—there is to be a diminution of inheritance in property. The new social life will be aristocratic in the sense that it will have a decisive stratum of pre-eminent and leading individuals who will wield a relatively large part of the power and property of the community but it will be democratic in the sense, that it will open to every one with ability and energy to join that stratum and participate to the extent of his or her ability or energy. In the formal picture presented to us of the world republic, we shall be fully adult—a state to which few come now, doubtfully and each one alone:

"We shall put away childish things, childish extravagances of passion and nightmare fears. Our minds will live in a living world-literature and exercise in living art; our science will grow incessantly and our power increase. Our planet will become like a workshop in a pleasant garden and from it we shall look out with ever-diminishing fear upon our heritage of space and time amidst the stars. We shall be man in common and each one of us will develop his individuality to the utmost, no longer as a separated and conflicting being but as a part and contribution to one continuing whole."

Who shall say that our author is not an optimist and Holist?

The contemplated metamorphosis of mankind, our William contends at an early stage of his dream, demands a life based on broader and sounder common ideas, expressed in new terms and new artistic forms, accompanied by nervous and other physiological changes. This necessity to change and expand extends from man's soul to man's chemistry.

It is strange that a reader of NATURE and a pupil of the Royal College of Science should be so Lamarckian as to proffer such doctrine or believe that it can be realised within any period that is worth our consideration. The lesson of Tutankhamen's tomb seems to be lost upon him. Obviously, he has little knowledge of what is known in science. We have learnt sufficient of man's vital chemistry *to know*, that it proceeds along lines which are little short of fixed. This must be so. If open to variation away from our type, we should be all over the shop, to use a vulgarism. Still, the human mind is strangely variable—subject at all times to the caprice of chemical change, every function apparently controlled by a chemical secretion. The woman, at regular intervals, we know, is heavily drugged. Male desire, of which our William has much to say in Book VI., is probably of chemical origin, due to chemical changes induced by mental processes.

Coming down to sense, human control of the world, as our William says, has been a control in detail; there has been no comprehensive control—because there has been no comprehensive understanding. Hence his indictment of our educational system in Book V. It is worth noting, he makes the point, that the mind of youth is the primitive, medieval mind—conservative and reactionary:

"Few minds are mature enough and stout enough before thirty to achieve a genuine originality. The originality of the young is for the most part merely a childish reversal of established things. The independence of the young is commonly no more than a primitive resistance to instruction. The youthful revolutionary is merely insubordinate and his extremist radicalism an attempt to return to archaic conditions, to naturalism, indiscipline, waste and dirt. The youthful anti-revolutionary turns back to mystical loyalties and romance."

It is necessary to educate the young for the new order. Sections 14 and 15 on supersession of schoolmasters and an inquest on universities must be studied to be appreciated—almost every word is telling. On an experience of sixty years, I am prepared to vouch for the substantial accuracy of the indictment. Much that is said, I have said over and over again.

Present-day education is nothing short of a pretentious farce—taking into account the changed and fast-changing state of the world. It promotes inaction, where action is needed above all things. It degrades and only accidentally promotes intelligence. It is in the hands of a class of men who are eyeless to the needs of the times, of men who never will respond to the call that is now made upon the teacher. Yet parents and guardians smugly accept what is and make no attempt to improve the conditions. Even our William, being a man of words, only half sees what is, what might

and what should be. Education was begun in the monasteries, to serve clerical ends. We have long since got rid of monasteries—Henry VIII. did that for us. It were now time that we abolished the monastic in education. Only don't let us substitute co-education, the emasculating invention of the Evil One. The effect of the monasteries was of small account in comparison with that now being exercised by the survival of the system of training they instituted—it will yearly become a greater peril to us. Our William is explicit on this point:

> " . . . the last human beings in the world in whom you are likely to find a spark of creative energy or a touch of imaginative vigour are the masters and mistresses of upper middle-class schools . . . these schoolmasters and schoolmistresses, . . . to whom we entrust nearly all the sons and daughters of the owning and directing people of our world, are by necessity orthodox, conformist, genteel people of an infinite discretion and an invincible formality. Essentially they are a class of refugees from the novelties and strains of life. I do not see how, as a class, they can be anything else. . . . The whole crowd of upper-class youth has been picked over again and again before the schoolmasters come; the most vigorous and innovating men have gone in for diplomacy, the law, politics, the public services, science, literature, art, business, the hard adventure of life; and at last comes the residue. . . . Its [the school's] mentality is the mentality of residual men.
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> " That is a neglected factor which has to be reckoned with in the history of the British Empire during the last hundred years. That is something the foreign observer has still to realise. A larger and larger proportion of its influential and directive men throughout this period have spent the most plastic years of their lives under the influence of the least lively, least enterprising, most restrictive, most conservative and intricately self-protective types it was possible to find. We have bred our governing class mentally, as the backward Essex farmer bred his pigs, from the individuals that were no good for the open market. The intelligent foreigner complains that the Englishman abroad has been growing duller and stiffer in every generation."
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> " The clue to the manifest change in character that Britain and its Empire have displayed during the last hundred years, the gradual lapses from a subtle and very real greatness and generosity to imitative imperialism and solemn puerility is to be found, if not precisely upon the playing fields of Eton, in the mental and moral quality of the men who staff the public schools."

A true bill. Italy, the one country where there is government, has no public schools. No other explanation is possible of the way in which the courage is gone out of us—of our loss of the art of government, the courage to govern, never more obvious than in the present coal strike—of the disappearance of the naturalist—of the decline of industry, *e.g.* the textile trade. The schools, to-day, it should be added, are greatly aided: golf and the motor-car serve to complete their insidious effect upon character.

Our William is nothing if not thorough—he would improve the public school and schoolmaster out of existence but recognises the need and desirability, under our present social condition, of schools of the preparatory class, largely staffed by women and not very big, where children up to fifteen could have a quasi-family life. (*N.B.*—The public school gone, these would be rid of the curse of the ' Common Entrance ' examination.) From fifteen onwards, the more directly a boy lives in contact with the real world, the better alike for the real world and himself. The reality of education for every one over fourteen, in a modern state, lies more and more outside any class-room; the fewer the school-made values a boy has, the juster will be his apprehension of reality. The new system will be one of special schools, studios and laboratories for arts, sciences, language and every sort of technical work. The style of work will be new.

All this is essentially sane. I saw the danger in early days and went so far as to express my opinion by saying, that I would not send my sons to a public school to save their lives and kept my word but was lucky in having at my door what was long, probably, the best day-school in London, if not in the country. I have also always held, that seventeen was the *very latest age* up to which a boy should be kept under monastic school conditions. I took my four boys away at that age and sent them to places of higher instruction, *where they were free to become men*. I have every cause to be satisfied: they may not be saints but neither are they serious sinners and the kick has not all been taken out of them.

The *Times*, on October 13, contained a most feeling obituary notice of Dr. E. A. Abbott, long well known as headmaster of the City of London School and a noted scholar. He is brought into comparison with F. W. Walker, the famous headmaster of St. Paul's School. We are told that Abbott, who relished Walker's half-cynical frankness of speech, used to relate how the latter showed him over his grand new school buildings at Hammersmith and how, when he (Abbott) expressed his admiration of everything and especially of the magnificent chemical laboratories, Walker replied: " Yes, they are all very well in their way; but, as we two are alone here, I may venture to say (lowering his voice to a confidential whisper) that you and I know that this sort of thing *is not education*."

Surely such an episode is disgraceful to both men. If ' this sort of thing ' were not education, why introduce it? If introduced, surely it was the headmaster's duty to see it made education. That two such men were able to scoff at a discipline that furnishes the key to

the comprehension of life is but proof of the hopeless narrowness and impenetrability of the classical and literary mind. Their attitude is that of most if not all our headmasters. 'Science,' we know, is a failure in schools—are the headmasters doing anything to improve the teaching, knowing as they must that to-day its dictates dominate the world?

Our William has something to say about science specifically but first let it be noted, that he extends his scepticism about schools to universities, particularly to "the universities for juveniles like Oxford, Cambridge, Harvard and Yale." We are all alive to the fact, that these are continuation boarding-schools, not free institutions as are the German universities. He is justified in his indictment, that there is a growing discontent with Oxford and Cambridge among those who have undergraduate sons—"sending their boys trustfully and hopefully to these over-rated centres, they find themselves confronted with pleasant, easy-going evasive young men up to nothing in particular and schooled out of faith, passion or ambition." I have said already, our William is an incomparable draughtsman. We must be prepared, he considers, to cut out this three or four-year holiday at Oxford or Cambridge and their American compeers from the lives of the young men we hope to see playing leading parts in the affairs of the world. So do I. We shall not get through with youths that are born tired, without method in their minds, such as we have to-day, who lapse into 'research' but make it an armchair occupation and put neither heart nor guts into the work.

To pass to specific science, our William's presentation of the Royal Society is of a piece with his appreciation of the universities. Perhaps it is worth while occasionally to see ourselves as others see us. He reports a meeting with his brother Dickon, at which the brother fingers his first paper in the *Phil. Trans.* The comments he makes are amusing and delightful parody.

"'Blastopore of the snail,' he objected. 'Fancy poking about at the blastopore of the snail! It's—indelicate. And cryo-hydrates! This chap Oliver Lodge seems to be all over them. Wonder what they are. Well, this is your affair, Billy. It's up to you to display the name of Clissold properly in these Philosophical Transactions. If that is the end of life. Not my pitch. Not in the least my pitch. I wouldn't try to see even a stethoscope through these Philosophical Transactions. No.'"

This is a confirmation, from outside, of the view I have often expressed, that the *Phil. Trans.* spell cremation, the *Proceedings* 'decent burial' of scientific discovery.

The brother, who has made his fortune out of advertising, then suggests giving the "dull old Philosophical Transactions" a real spirited Xmas number, a genuine advertisement display, with which "Temptation of St. Antony" won't be in the same field. The final opinion expressed by Dickon, to meet his brother's objection, that advertising would be vulgar, is again a noteworthy criticism:

"'If there's anything vulgar about modern advertising it's because it's been so concerned about pills and soap and pickles. Just a passing phase. A man or a class or a religion or—anything that will not advertise isn't fit to exist in the world. It means it doesn't really believe in itself. To want to exist and not to dare to exist is something beneath vulgarity. . . . That's why I have such a contempt for your rotten, shy, sit-in-the-corner-and-ask-the-dear-Prince-of-Wales-to-dinner-once-a-year-Royal Society. If the soap-boilers did no more for soap than your old Royal Society does for science,' said Dickon, 'nobody would wash.'"

Formerly, the opinion of the Society was often consulted in matters of importance to the State; now, the Department of Scientific and Industrial Research is more and more usurping this office. The individual original scientific worker, like the naturalist, may easily soon be ruled out of existence and an unimaginative being put in his place. We confine our activity to publishing work which is either largely premature and unfinished or even better left unpublished. Few attend the meetings and, at these, soft nothings are said and no one dare criticise. "We work submerged, we talk by no more than twos and threes," says our mentor. This is the way of the Society. It cannot be brought, it makes no attempt, to realise, how essential it is to organise the forces of science into a living body—what it could do if it formed itself into a great consultative scientific House of Peers. The only office it effectively serves is that of back-patting and bemedalling the supposed élite of the craft.

As our William truly remarks, "No great creative development can go on in modern social life beyond a certain point without a literature of explanation and criticism." We have no such literature: the result is that work is done and little use made of it. We keep no more than a casual profit-and-loss account and never seek systematically to balance our books. Our knowledge is never properly sifted and sorted and its values determined—no logical order is observed in filling in the blanks.

May it not be true that few would wash, if no more were done for soap than we do collectively for science? Is it policy to go on producing, paying insufficient attention to quality and demand, without taking proper steps to popularise and sell? Industry, to-day, we know is largely engaged in producing and forcing the sale of unnecessary goods: this is the manufacturers'

conspiracy. If we are not coming very near to producing goods and leaving them to rot, we are doing little to secure digestion of the food we provide. We finish nothing. To take an example. Cane sugar is now made, all but pure, in millions of tons and yet chemists cannot tell the manufacturer what it is—how its atomic bricks are built together. Children are put to such work, not experts: to-day, these are engaged in the study of poison gases.

Research work is fast being made an entirely selfish, narrow occupation, when not carried out for industrial purposes. A bureaucratic class of academic workers is fast growing up, fit for little more than drawing-room service, without practical outlook. We need a few Fords to introduce efficiency into the research machine —Mr. Ford is said to have a greater annual turnover of work-people than any other employer, which means that he takes the efficiency of the worker into account: our up-growing civil service, research system does not: the threatened result is that 'research' will become a merely parasitic occupation. The term will disappear from the field of practice.

We work submerged, says our William. We hand on our impressions and vague intentions only by the most fragmentary hints. In education nothing is done to record, preserve and utilise successful trials of method. Sanderson left no record of method behind him and to-day, apart from his buildings, Oundle has nothing to show of his influence—it has reverted to the primitive school type. His Home of Vision has no vision in it. One teacher succeeds another without ever considering his predecessor's methods. The Finsbury Technical College was proclaimed a success but its methods are on the dust heap.

Before attempting to form a world directorate, we need to run our own little shanty: to take notice of one another and be sympathetic and work together to make it really habitable for all. Not only leaders are needed but the apparatus also is not there. It is all very well to repeat Carlyle's saying, that the modern university is an university of books the books are not there. Even in leisure hours, you cannot live on the dull-as-ditch-water-doings of a no-sight family, with or without spoons. Writers of the day have no knowledge within them to use, thanks to their schooling. Here is our William's future opportunity: he is only fifty-nine and has time to turn over many new leaves. Let him write up to his professions, to show, if possible, how the new and necessary knowledge may be brought home to youth and made of some general avail. He has recognised his and our limitations, in his preface, in a single line, which is probably the most significant in the book, in saying of men of the type of "the devout Mr. Belloc, the aristocratic Duke of Northumberland, the political Mr. Ramsay MacDonald," that he can only comment upon such types. *Their ultimate processes are inconceivable to him.*

We are all cryptic beings and no one of us is open to the complete inspection of his fellow-man. We differ vastly in mentality. This is why Oxford is obdurate and will teach nothing that is needed by the world to-day. The word-slingers it trains throw from empty slings—at times perhaps a few very beautiful stones from the past but not the bullets of to-day. By a strange process, by securing control of the schools by men of its own type, it has made itself a community of one type of mentality, with but few escapes from its rigidity: the mechanism for the appreciation of modern things is not built into the type. We shall never improve our system of education and make it fit the needs of the times until we take into account, in the most liberal manner possible, the strange variability of the human mind. Society being composed of all sorts and conditions of men, to provide for all will always be very difficult, the less, however, the more we are alive to the differences and not too immodest in our individual opinions.

HENRY E. ARMSTRONG.

Our Bookshelf

A Practical Treatise on Outbreaks of Fire. By Sidney Gompertz Gamble. Pp. xii + 543. (London: Charles Griffin and Co., Ltd., 1926.) 30s. net.

THE author of this book held for twenty-six years the position of second in command of the London Fire Brigade, and prior to this had the experience of seventeen years as borough surveyor and chief officer of the fire brigade in a provincial town. The knowledge thus obtained and embodied in his book causes it to appeal strongly to members of fire brigades and to all concerned in minimising fire risks. The volume is divided into five parts dealing respectively with (1) natural science, legal and general matters; (2) fires and their causes, together with insurance; (3) means of suppression, material and personnel; (4) fire prevention and construction of buildings from the fireman's point of view; (5) miscellaneous matters. Besides providing a great deal of information with which the fireman in service ought to be acquainted, presented in a form which he can appreciate and use, the book contains much that is of interest to the layman. The section dealing with the causes of fires makes very interesting reading, and many of the various cases are illustrated by photographs; this section also deals in detail with dangerous trades, and discusses the precautions which should be observed in them. Another section contains much that will be of value to the officer whose duty it is to report on suspected cases of arson and incendiarism. Fully illustrated details of automatic and other systems of fire notification are included as well as sprinkler systems.

A feature of the book which assists in rendering it very readable is the historical notes freely scattered among the pages. The illustrations of fire appliances

from the earliest times down to those in present use are extremely good, and the historical account of the progress of the fire-engine is especially interesting. The principles on which modern pumps work are explained adequately, and multiple centrifugal pumps are included. Fire prevention and panic in places of public resort is a wide subject which concerns the whole community, and the author devotes a great deal of space to it. Such buildings are classified, and each type is treated separately. Remembering the wide experience which Mr. Gamble has had in London, his opinions must be taken as authoritative, and will be invaluable to surveyors under public bodies. We have nothing but praise for this book, and consider that the author has rendered service, not only to the members of his own profession, but also to the public, in presenting so much that is of value in such an acceptable form.

Ergebnisse der exakten Naturwissenschaften. Herausgegeben von der Schriftleitung der *Naturwissenschaften.* Fünfter Band. Pp. iii+329. (Berlin: Julius Springer, 1926.) 21 gold marks.

THIS collection of articles by leading continental men of science possesses a great amount of interest for students of physical science, both pure and applied. Thus, we have an article on planetary radiation by Prof. Schoenberg, which is followed by a comprehensive treatment of the measurement of photographs by Dr. Seliger, and by an article on dynamic meteorology by Prof. Wegener. Prof. Bjerrum gives a very interesting account of the electric forces between ions and their effects, and Prof. Pringsheim gives an account of work on the photo-electric effect in gases, in which he describes the recent work of Foote, Mohler, and Auger. The article on atomic disintegration, by Dr. Kirsch, gives a survey of the experimental results obtained in Cambridge and Vienna, and the author attempts to interpret these results in terms of the explosion theory advanced by Pettersson. The experimental proof of the statistical nature of the law of radioactive decay is treated in a further section, by Prof. Kohlrausch, who pays particular attention to the work of Frl. Bormann, which provides, in his opinion, the first conclusive experimental proof of the correctness of the fundamental assumption on which the law is based. The absorption of gases under the influence of electrical discharge and allied phenomena are considered in full in an article by Dr. Pietsch, to which are appended several pages of references. Finally, we have an excellent and up-to-date account of the Compton effect by Drs. Kallmann and Mark.

Edward Thring, Maker of Uppingham School, Headmaster 1853 to 1887. By W. F. Rawnsley. Pp. iv+103. (London: Kegan Paul and Co., Ltd., 1926.) 3*s.* 6*d.* net.

EDWARD THRING and Sanderson will rank as the two English headmasters of the last generation who left most personal mark upon their scholars and built up great schools on the foundations of small, ancient, and neglected grammar schools. Such reconstruction was a familiar feature of the last half-century, but Uppingham and Oundle will always recall the names of their re-founders. Thring's work was in one way more heroic than Sanderson's, because he did it in the teeth of an obstructive and unsympathetic body of governors, while Sanderson was supported by the generous and loyal help of his.

In this short account of Thring's career, Mr. Rawnsley gives a vivid picture of the man and explains his extraordinary personal influence. Thring had in a high degree that combination of humour, sharpness, sympathy, and devotion which makes the strongest appeal to the English boy. Numerous examples are given of all these and of his cardinal principle in education that every boy is good for something and that you must make him work by appealing to his individual interests. Thring's own interests lay mainly in music and literature, and one does not hear anything of science or history. In this respect he and Sanderson would seem to have been rather complementary to one another. Both stand out as worthy types of the individuality of the great headmaster.

F. S. M.

A Text-Book of Experimental Psychology: with Laboratory Exercises. By Dr. Charles S. Myers and F. C. Bartlett. Third edition. Part 2: Laboratory Exercises. Pp. viii + 121. (Cambridge: At the University Press, 1925.) 7*s.* net.

IT is satisfactory to note that this excellent text-book is now in its third edition. The student who has carefully worked through these exercises will have gained considerable practice in the very difficult art of psychological experiment. There is a fairly common belief that psychology can be evolved from the writers' inner consciousness without the limiting effects of an appeal to facts demanded by other branches of knowledge. Much futile discussion and many fantastic theories would be avoided if all exponents of psychology could have the discipline of working through this book.

There are four sections, designed to cover about a year. The first part deals with the technique of psychological experiment, the second with problems of the special senses, the third with perception and the higher thought processes, while the fourth is supplementary, giving additional experiments.

This revised reprint will be very useful.

Die Gattung Synedra in systematischer, zytologischer und ökologischer Beziehung. Von Dr. Konrad Gemeinhardt. (Pflanzenforschung, Heft 6.) Pp. iv+88+4 Tafeln. (Jena: Gustav Fischer, 1926.) 6 gold marks.

THIS monographic treatment of the abundant diatom genus Synedra will appeal chiefly to the specialist, but is not without points of general interest. The author supports a classification based on the features of the valves rather than on the characters of the chromatophores and throws out a suggestion that nuclear structure may afford a basis for distinguishing the larger groups of diatoms. No proper spindle is formed during nuclear division in Synedra, and a centrosome is lacking. In the considerable section devoted to ecological data it is made clear that all species of Synedra require water with a certain minimum lime-content. It is significant that, in the course of more than a year's continuous observation, no auxospore-formation was observed.

Letters to the Editor.

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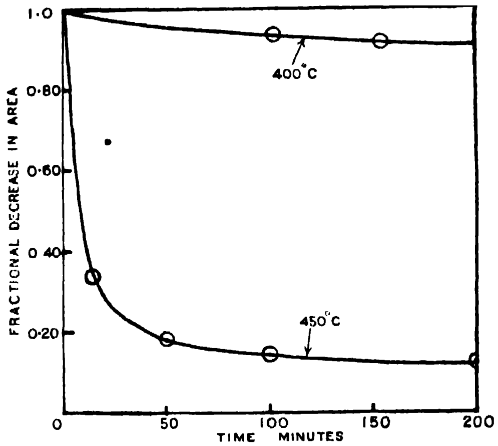
The Structure of Catalytically Active Copper.

THE nature of the change that occurs on the activation of a metallic catalyst by alternate oxidation and reduction, or by continued use, and the change that occurs during sintering, has been an open question (cf. *Proc. Roy. Soc.*, A, vol. 107, p. 277; vol. 110, p. 283). The solution of this problem



definitely would go far towards establishing the theory of centres of activity on an indisputable foundation, since it is necessary to show that both the area and the nature of the surface change (cf. the discussion by Hinshelwood, "Kinetics of Chemical Change in Gaseous Systems," Clarendon Press, p. 194).

Now the observations of Dunn (*Proc. Roy. Soc.*, A, vol. 111, p. 210) on the use of interference colours, in following quantitatively the growth of the oxide film on copper, give a method of estimating the linear rate of growth of the oxide covering the individual grain compared with that on 'inactive copper.' Palmer (*Proc. Roy. Soc.*, A, vol. 103, p. 444) showed that the conductivity of a mixed copper–copper oxide film was directly proportional to the copper content of the supported film, thus the rate of fall of the conductivity of the film is a measure of the mass of copper being oxidised in unit time, and a method is available for estimating the massive rate of growth of the oxide compared with that on 'inactive copper.'

Let a be the thickness of the oxide film, S represent the area of surface, and C be the electrical conductivity of the mixture of oxide and metal. Let the suffix 1 denote the values of these quantities for an activated or sintered catalyst, at time t after the commencement of the oxidation at constant temperature; and the suffix 2 represent the same variables either for the film before activation, or for the fully activated film before annealing.

Then

$$\frac{\left(\frac{da}{dt}\right)_1 \cdot S_1}{\left(\frac{da}{dt}\right)_2 \cdot S_2} = \frac{\left(\frac{dC}{dt}\right)_1}{\left(\frac{dC}{dt}\right)_2}. \qquad (1)$$

Thus S_1/S_2 can be evaluated, and we have a method of measuring the increase of area on activation, and the decrease of area on sintering.

The observations for the activation of a catalyst present experimental difficulties, owing to the irregular nature of the first reduction and oxidation in many cases; but they are of great theoretical interest and, so far, seem to indicate that the increase in area of the supported copper films on successive reduction is not large. The nature of the surface alters considerably, since the linear rate of oxidation increases markedly.

In the case of sintering, the observations can be made with accuracy; the nature of the surface is changed since the linear rate of oxidation falls, and the increase in surface area is marked. Continued exposure to high temperature does not cause the area to diminish indefinitely, but a definite limit is reached corresponding to each temperature. The effect of annealing a supported copper film at 450° C. and 400° C. is shown in the accompanying diagram (Fig. 1), the results being worked out by the method previously described.

The relative rate of increase of thickness of the oxide film slows down very considerably, as the time of sintering is increased. Dunn's conclusions (*loc. cit.*) that "the structure of a metal may be brought out owing to the variation of the oxidation rate of different crystal faces," and that "For a definite time of oxidation each crystal face will be characterised by a different colour," seem to provide indisputable evidence that, as well as the area change that occurs during activation and sintering, there is also an unmistakable change in the nature of the surface.

F. H. CONSTABLE.

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Cambridge.

Magnetic Properties of Single Crystals of Nickel.

THE magnetic properties of single crystals of iron have been examined by Webster (*Proc. Roy. Soc.*, **107**, p. 497, and **109**, p. 570), Honda, Kaya, and Masuyama (NATURE, May 29, 1926), and more recently Gerlach (*Zeit. für. Phys.*, **38**, p. 828, 1926). Considerable differences have been shown to exist between the

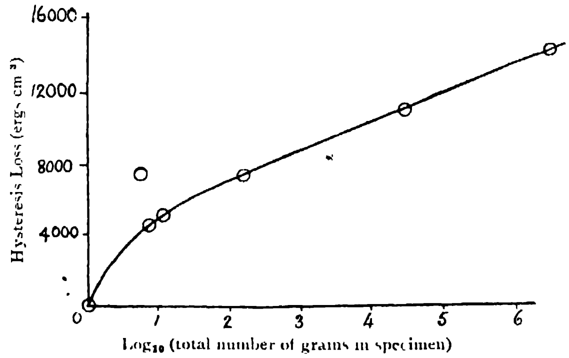

FIG. 1

magnetic properties of the polycrystalline metal and the single crystal.

We have recently succeeded in preparing crystals of nickel of several cubic centimetres in volume, from which specimens large enough for magnetic measurements can be obtained. The present note contains an account of a preliminary investigation on the variation of hysteresis loss with grain size. The specimens used were cylindrical rods of 20 mm. by 2 mm. diameter. The hysteresis loss, as in the case

of iron, decreases with the number of grains in the specimen, as shown in the accompanying graph (Fig. 1) and table.

Number of Grains in Specimen.	Hysteresis Loss (ergs/cm.^{3}).	Coercive Force (Gauss).
$2\cdot8 \times 10^6$	14,600	13
$2\cdot7 \times 10^4$	11,100	10
$6\cdot4 \times 10^2$	7,300	5
12	5,150	4·3
8	4,500	3·7
1	< 290	< ·5
7	7,600	5

The hysteresis loss for a single-crystal specimen was less than the experimental error, and was certainly less than 1/50 of that for ordinary nickel. The point off the curve was obtained with a specimen containing seven grains. In this particular case the etch pattern indicated that the grains were considerably distorted. For the specimens containing eight and twelve crystals respectively, the demagnetising factor was appreciably greater than for the other poly- and single-crystal rods of the same dimensions. In these two cases it is significant that most of the crystals occupied the whole cross-section of the rods. Gerlach's experimental results for iron indicate the presence of similar phenomena in that metal.

The intensity of magnetisation of the single crystal specimen in an effective field of 300 gauss was 565 units. Saturation was not complete in this field.

Further experiments on the magnetisation and magnetostriction along the different crystalline axes are in progress.

W. SUCKSMITH.
H. H. POTTER.

Physics Department,
University of Bristol,
October 14.

Invention as a Remedy for Unemployment.

THE very interesting analysis of the relationship of present patent law and patent procedure to invention and to the unemployment problem, which appeared in NATURE of September 18, should serve to stimulate clear and earnest thinking on a subject of great national importance.

A storm of indignant protest is always aroused if any one has the temerity to suggest that Great Britain is falling behind in the application of science to industry, or in the practical application to useful ends of newly discovered scientific truths. I am, nevertheless, of the opinion that, except perhaps in the allied fields of steam and marine engineering, it would be difficult indeed to prove that some such declension from our former pre-eminence has not taken place. It would be a wearisome task, and certainly provocative of controversy, to recite the evidence in support of this view, but an unprejudiced observer who considers, for example, the course of invention during recent years in such fields of useful activity as incandescent gas-lighting, electric traction, alternating-current engineering, or in the design of type-writing, addressing, and calculating machinery, will find it difficult to resist the conclusion suggested above.

That this failure to lead in the realm of commercial invention is not due to any diminution in the mental energy or native ingenuity of the race is abundantly evident from the splendid achievements of British scientific workers during the first quarter of the twentieth century.

It is probably true that since the death of Faraday the international reputation of British science has never stood higher than it does to-day.

I would in particular direct attention to the astonishing experimental skill and inventive ingenuity which have distinguished the work of our physicists. Without citing any names or making any detailed and, possibly, invidious comparisons, it may safely be claimed that in this respect no other nation has surpassed—if any have equalled—the freshness and power of attack exhibited by British workers.

Even in the realm of organic chemistry, in fields formerly almost abandoned to foreign labourers, the achievements of British investigators and inventors during the last eight or nine years constitute a truly wonderful record of steady progress in one of the most difficult of applied sciences. The same story of rapid and successful attack can be told in connexion with the manufacture in Great Britain of optical and heat-resisting glasses.

In all this there is abundant room for encouragement; for it makes clear the fact that where we are failing to lead in applied invention and applied scientific method, the failure is not due to lack of inventive ability.

It suggests that in countless instances invention is inhibited and inventors discouraged by the fact, still lamentably true, that the average Englishman possessing money—the man to whom new ideas are brought for development—is hopelessly at sea in respect of general scientific knowledge and general manufacturing processes. More often than not he is a gentleman, a man anxious to act fairly towards his fellows, and a man not unenterprising—quite willing, in fact, to risk money wherever he believes there is a reasonable chance of winning more—but the words the inventor uses and the drawings he exhibits are expressions in an unknown tongue.

The man of money remembers more of the Greek and Latin he laboriously learned at school than of the fragments of mechanics or chemistry he imbibed under the head of 'Science.' He turns the inventor down because he does not understand.

This inability does not prevail to anything like the same extent in the United States of America or in Germany. Generally speaking, in those countries the man who commands money knows at least enough of mechanics, or physics—knows enough about *things* as distinguished from *words*—to take a very intelligent interest in what an inventor has to say.

That makes all the difference.

A classical education may be the best possible preparation for any calling that succeeds it—I happen to think this is so—but the price Great Britain has paid, and is paying now, for the past almost total neglect of science in our public schools is incredibly big.

Until science, and 'knowledge of things,' take their proper place in our great schools, invention will continue to languish and inventors to cross the Atlantic.

Reform of the patent laws may certainly help the cause of invention, but alone it will not do nearly enough.

I would warmly advocate a more thorough and a wider official search, as in Germany and in the United States. I would also advocate the establishment of a British petty patent similar to the German *Gebrauchsmuster*, so as to eliminate the absurdity of giving the same kind of protection to a man who 'invents' a method of making some simple object

out of sheet-metal instead of casting it, as to the inventor of the steam turbine.

The issue of such patents as are suggested above is one of the least creditable branches of the Patent Office's activity during recent years.

The encouragement of real inventiveness will unquestionably diminish unemployment. Even in the case of 'process' and 'cheapening' patents, any temporary increase of unemployment thus created is more than balanced by increased production, and the consequent absorption of more and more men into employment. Generally speaking, the world is always hungry for goods, if the goods are useful and the price is right.

W. A. BENTON.

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A Breeding Ground of the Nursehound (*Scyliorhinus stellaris*) in the Fal Estuary.

DURING recent years I have had considerable experience on the oyster-beds and adjacent grounds in the Fal Estuary, and as a result of observations made at various times I consider that the greater part of the Laminarian zone in that estuary forms an extensive and regular breeding ground for the nursehound (*Scyliorhinus stellaris* = *Scyllium catulus*). In the autumn of 1924 a few egg-cases containing embryos of this shark-like fish were dredged on Laminaria on the Falmouth North Bank, Carclase, and on other grounds in ½ to 1½ fathoms. (A chart of the grounds of this region is given in my report on a "Survey of the Fal Oyster Beds," 1926.) During the summer of 1926, egg-cases have been frequently taken on Laminaria at Turnaware Bar—which is situated about 1½ miles farther up the estuary than the grounds just mentioned—and young ones recently escaped from the egg-case have been seen at low water on this ground on several different occasions. Young nursehounds have also not infrequently been taken in oyster-dredges in autumn.

During the recent spring tides, the Laminarian zone at Brown Rose Bar—about 1 mile below Turnaware—was being examined for oysters, and, in an area of not more than 20 square yards, 8 egg-cases of the nursehound containing eggs or embryos, as well as a few empty purses, were found; probably others were on the ground and not seen. Two of these egg-cases had been laid within the last few days, and had the thong-like horny extensions of the corners of the case wrapped round the whole of the anastomosing roots of a bunch of old Laminaria stipes. In one instance the new egg-case had been attached to a group of stipes which also carried older egg-cases at a higher level. Four of the egg-cases contained embryos respectively about 12·5 cm. and 10 cm. long, both with internal gills, and two about 6·0 mm. long. It is interesting to note that Ford (*Jour. Mar. Biol. Assoc.*, vol. 12, p. 492, 1921) estimated that embryos would begin to have the gills covered at a length of about 10·0 cm. Thus the collection of egg-cases contained eggs or embryos of four different ages, and therefore of four different spawnings.

While examining one egg-purse in its natural position under water, two *Nassa reticulata*, sometimes called dog-whelks, were observed with their probosces inserted in a natural crack in the case, where the base of one corner thong arises from the body of the case. After observing the Nassæ for a few minutes, each was pulled off separately and at least half an inch of pink proboscis pulled out of the case. On opening the case, however, to see what damage had been done, there was found no trace of either yolk or embryo and only a remnant of albumen. As the purse was fixed in an upright position in the water, and the Nassæ were at the lower end, it was possible—but not probable—that they might have eaten the large amount of yolk generally found in the eggs, but on examining the other egg-cases, one similar in age to that attacked by the whelks was opened and also found to contain nothing but albumen, although the egg-case was intact and full of albumen.

It is clear, therefore, in this latter instance, that the nursehound had made an egg-case and had omitted—perhaps forgotten—to put an egg in it. The contents of both these purses were healthy in so far as they had no noxious smell. It is not improbable that Nassæ and similar forms may normally attack the embryos of the nursehound and its allies at the vulnerable natural slits in the egg-case (described by R. S. Clark, *Jour. M.B.A.*, vol. 12, p. 584, 1922).

It is well known that the nursehound breeds regularly in the gullies at Wembury Bay West, inside the Mewstone, near Plymouth, but there the egg-cases are usually attached to the strong, stockily growing sea-weed Cystoseira. It would seem, therefore, that so long as the nursehound can lay its egg-cases in fairly shallow water—on the south coast of England—the fish may use either Laminaria or Cystoseira and probably any other weed so long as it be strong and permanent enough. It is necessary that the weed used for attachment should remain *in situ* for nine months to a year, and perhaps longer, to enable the embryo to develop fully; and presumably the spawning fishes know that both Cystoseira and Laminaria are both strong enough and permanent enough even in a situation near low-water mark to serve their purpose; Cystoseira, from observation, grows certainly for more than one year, and is so firmly rooted that it is either difficult or impossible for a man to pull the weed off the rock. *Laminaria saccharina*, the species used by the nursehound, may shed its frond at the end of one summer's growth, but the stipes to which the egg-case is attached remains *in situ* and strong for a much longer period. The problem of how the nursehound found out that Laminaria and Cystoseira would suit its purpose is only one more of the millions of evolutionary problems awaiting explanation.

J. H. ORTON.

Marine Biological Laboratory,
The Hoe, Plymouth, October 21.

Application of the Drop Weight Method to the Determination of the Surface Tension of Colloidal Solutions.

IN connexion with some work by Henry N. Harkins and myself on the surface tension of certain colloidal solutions, it seemed essential to hold the drop used for the determination at almost full extension any desired length of time before it was allowed to fall. As usual, the drop was allowed to fall from a tip of horizontal circular cross-section into a stoppered weighing bottle (method of J. L. R. Morgan). The weighing bottle was immersed in a thermostat, and was kept dry on the outside by an enclosure of glass and brass, such as was used by Harkins and Brown. This is shown diagrammatically in Fig. 1. The new modification consisted in supporting the supply bottle entirely by the rod A, which was supported in turn by a microscope stand upheld by a heavy tripod which rested on a pier outside the thermostat. The rod was made so small that there was no contact with the inside of the tube C′. There should also be no contact between the stopper of the bottle E and the inverted capillary U tube upon which the tip D is

ground, since the adjustment of the level of the bottle E must transmit no vibrations to the hanging drop.

The form of the drop which hangs from the tip D depends both upon R/a and R/h. Here R is the radius of the tip, a is the square root of the capillary constant, and h may be designated as the 'pressure-height,' which is the difference in height between the bottom of the drop and the level the liquid in the bottle E would have provided the area of its meniscus were infinite.

The method was applied to pure liquids by Dr. Paul Gross, and it was found that the accuracy of the drop weight method is thereby increased considerably, so that the precision of the new method is to within a few hundredths of one per cent. To apply the method the cross-hair of the telescope of a cathetometer is adjusted by trial with the hanging drop, so that its level corresponds to the lowest level at which the bottom of the drop may be held without falling. To attain this level the height of the meniscus in E is adjusted by trial to the proper height by the use of the coarse and fine adjustments of the microscope stand. If the proper technique is used, the drop may be held at practically full extension for as many hours as may be desired. A study of the relation between the pressure-height and the stability of the hanging drop was carried out by Dr. Gross, and the results will be presented in a later more complete discussion of the improvements in the drop-weight method. The modifications introduced do not of necessity lengthen the time necessary for a determination of surface tension, since the greater certainty with which the proper conditions may be attained makes it possible to reduce the number of drops used, and in much work on colloidal solutions only one drop needs to be allowed to fall in the final determination.

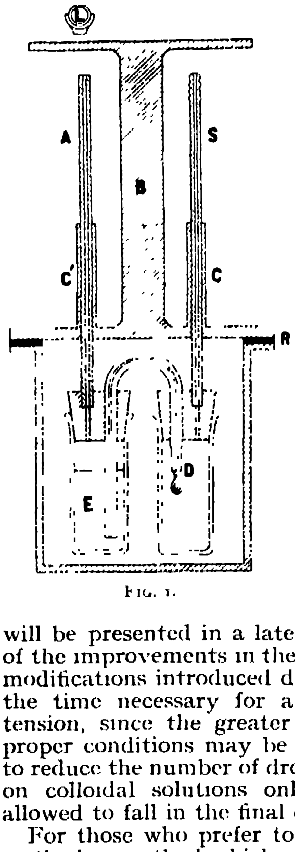

FIG. 1.

For those who prefer to use the less accurate ring method, a method which as commonly used has been in error by so much as ten per cent. or more, it may be mentioned that Dr. T. F. Young, Y. C. Cheng, and the present writer have recently determined experimentally the corrections for this method. The use of these corrections reduces the error to one per cent., and it is hoped that the work now under way will still further reduce this to one-tenth per cent.

WILLIAM D. HARKINS.

University of Chicago,
September 16.

Tertiary Man in Asia: the Chou Kou Tien Discovery.[1]

A RICH fossiliferous deposit at Chou Kou Tien, 70 li [about 40 kilometres] to the south-west of Peking, was first discovered in the summer of 1921 by Dr. J. G. Andersson and later surveyed and partially excavated by Dr. O. Zdansky. A preliminary report on the site was published by Dr. Andersson in March 1923 (*Mem. Geol. Surv. China*, Ser. A, No. 5, pp. 83-89), followed in October of that year by a brief description of his survey by Dr. Zdansky (*Bull. Geol. Surv. China*, No. 5, pp. 83-89). The material recovered from the Chou Kou Tien cave deposit has been prepared in Prof. Wiman's laboratory in Upsala and afterwards studied there by Dr. Zdansky. As a result of this research, Dr. Andersson has now announced that in addition to the mammalian groups already known from this site, there have also been identified representatives of the Cheiroptera, one cynopithecid, and finally two specimens of extraordinary interest, namely, one premolar and one molar tooth of a species which cannot otherwise be named than *Homo ? sp.*

Judging from the presence of a true horse and the absence of Hipparion, Dr. Andersson in his preliminary report considered that the Chou Kou Tien fauna was possibly of Upper Pliocene age, an opinion also expressed by Dr. Zdansky. It is possible, however, in the light of recent research, that the horizon represented by this site may be of Lower Pleistocene age. Whether it be of late Tertiary or of early Quaternary age, the outstanding fact remains that, for the first time on the Asiatic continent north of the Himalayas, archaic hominid fossil material has been recovered, accompanied by complete and certain geological data. The actual presence of early man in eastern Asia is therefore now no longer a matter of conjecture.

While a complete description of these very important specimens may shortly be expected in *Palæontologia Sinica*, the following brief notes may be of interest here. One of the teeth recovered is a right upper molar, probably the third, the relatively unworn crown of which presents characters appearing from the photographs to be essentially human. The posterior moiety of the crown is narrow and the roots appear to be fused. The other tooth is probably a lower anterior premolar, of which the crown only is preserved. The latter also is practically unworn, and appears in the photograph to be essentially bicuspid in character, a condition usually to be correlated with a reduction of the upper canine.

The Chou Kou Tien molar tooth, though unworn, would seem to resemble in general features the specimen purchased by Haberer in a Peking native drug shop and afterwards described in 1903 by Schlosser. The latter tooth was a left upper third molar having a very much worn crown, extensively fused lateral roots, and from the nature of its fossilisation considered by Schlosser to be in all probability Tertiary in age. It was provisionally designated as *Homo ? Anthropoide ?* It is of more than passing interest to recall that Schlosser, in concluding his description of the tooth, pointed out that future investigators might expect to find in China a new fossil anthropoid, Tertiary man or ancient Pleistocene man. The Chou Kou Tien discovery thus constitutes a striking confirmation of that prediction.

It is now evident that at the close of Tertiary or the beginning of Quaternary time man or a very closely related anthropoid actually did exist in eastern Asia. This knowledge is of fundamental importance in the field of prehistoric anthropology; for about this time also there lived in Java, Pithecanthropus; at Piltdown, Eoanthropus; and, but very shortly after, at Mauer, the man of Heidelberg. All these forms were thus practically contemporaneous with one another and occupied regions equally far removed respectively to the east, to the south-east, and to the west from the central Asiatic plateau which, it has

[1] Announcement of the Chou Kou Tien discovery was first made by Dr. J. G. Andersson on the occasion of a joint scientific meeting of the Geological Society of China, the Peking Natural History Society and the Peking Union Medical College held in Peking on October 22, 1926, in honour of H.R.H. the Crown Prince of Sweden.

been shown elsewhere, most probably coincides with their common dispersal centre. The Chou Kou Tien discovery therefore furnishes one more link in the already strong chain of evidence supporting the hypothesis of the central Asiatic origin of the Hominidæ.

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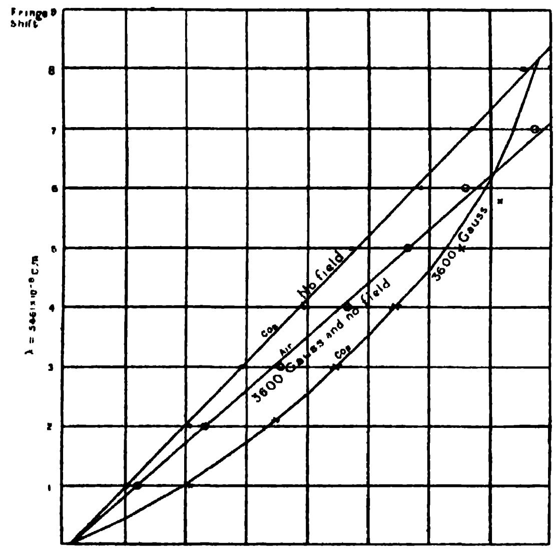
Action of Magnetic Fields on the Refractive Index of Carbon Dioxide Gas.

A. GLASER (*Ann d Physik*, 75.4, pages 459-488, and *Ann. d. Physik*, 78 4, 641-658), in determining the susceptibility of diamagnetic gases, noticed that, under a definite magnetic field, the susceptibility decreases as the pressure of the gas is decreased, approximately proportional to the pressure. For a certain pressure range, however, there is a deviation from the above law, and the law of variation, instead of being linear, follows approximately a parabolic law, and above and below this range the linear law has different characteristics.

Working to detect any relationship between the refractive index and pressure, Fraser (*Phil. Mag.*, April 1926, pp. 885-890), using the Jamin refractometer, failed to notice any change in the refractive index when the gas is subjected to a sudden magnetic field of about 184 gauss within a pressure range of 0·001 to 8 mm.

The present authors have noticed a decided change in the refractive index of pure dry carbon dioxide gas,



when subjected to a constant magnetic field of 3600 gauss, acting transversely to the direction of propagation of light and the pressure gradually increasing from 10 mm. to 400 mm. A Michelson type of interferometer was used for the purpose, and all parts were carefully selected to be non-magnetic. The graph (Fig. 1) shows the relation between the shift of fringes and the pressure variation within the range 10 mm. to 400 mm. for air and carbon dioxide. In the case of air, the magnetic field has no influence whatever on the refractive index, whereas with carbon dioxide the fringe shift nearly follows a parabolic path in the same region of pressure, as has been noted by Glaser. This shows a decided orientation of the molecules under the magnetic field, at least in the case of a dipolar gas of the type of carbon dioxide.

Experiments are in progress to determine the change with different temperatures and other dipolar gases.

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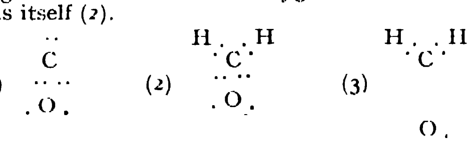
September 29.

Electron Displacement *versus* Alternate Polarity in Aliphatic Compounds.

ADHERENTS of the theory of induced alternate polarity in carbon compounds consider in their deductions also the general electron displacement effect of Lewis's theory; some partisans of the latter theory, however, question the reality of the alternate effect, especially so far as open-chain compounds are concerned. (Cf. H. F. Lucas and co-workers, *J. Am. Chem. Soc.*, 46, 2475 (1924); 47, 1462 (1925).)

It seems to me that recent results of V. Henri and Sv. A. Schoú [*C. R. Acad. Sci. Paris*, 182, 1612 (1926)] afford strong evidence in favour of the alternate effect. Making use of spectroscopic data, these authors succeeded in determining the distances between the atoms in some simple organic molecule, in the gaseous state. They find for the distance between the carbon and oxygen atoms in carbon monoxide 1·02 Å.U., whereas the same distance in formaldehyde is found to be 0·9 Å.U. It is just such a *decrease* of the distance carbon to oxygen by the presence of the two hydrogen atoms, that would be expected on the basis of the alternate polarity theory.

Indeed, let us suppose for the sake of comparison that in carbon monoxide the four binding electrons are lying at equal distances from the nuclei of the two atoms (1). In formaldehyde, then, according to the alternate effect and considering the positivity of the hydrogen atoms, the carbon atom must become less positive, *i.e.* it attracts the electrons of its octet, and together with them the oxygen nucleus, nearer towards itself (2).



(1) (2) (3)

On the contrary, the general Lewis effect would require a displacement of the binding electrons towards the oxygen nucleus, and thus an *increase* of the distance between carbon and oxygen (3).

In phosgene, $COCl_2$, the reverse effects would be expected according to both theories on account of the negative chlorine atoms; the data for distances are, however, not yet available in this case.

If one assumes a triple bond in carbon monoxide (cf. Lewis, "Valence," 1923, p. 127), the above conclusions become doubtful, since it is not known how interatomic distances are influenced by the transition of bonds; only a direct comparison of the distances in formaldehyde and phosgene could afford conclusive evidence then.

G. BERGER.
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October 5.

Science and Psychical Research.

MY departure for New Zealand having been delayed for a month, perhaps I may be allowed a short reply to Sir Bryan Donkin's remarks in NATURE of Nov. 6. Sir Bryan and myself have come much closer in our views, apparently, but he still misunderstands some of the main points both in my original article and following letter. The term ' supernormal phenomena ' certainly includes both ' physical ' and ' mental ' phenomena of the type under discussion ; on that we are agreed. But Sir Bryan goes on : " In the mental part, however, are included practically all the various ' phenomena ' known generally under the term ' spiritualistic,' " or, later in his letter, ' ghostly.' It is here that I disagree. The genuine psychical researcher does not allow that these may be termed either, since both words connote a hypothetical explanation of the phenomena which we hold is not yet proven. Sir Bryan keeps trying to tie me down to an acceptance of the spiritistic hypothesis, whereas the whole of what I have written shows clearly that I am studying the evidence with an absolutely open mind. Another remark of his, " Seeing that the present discussion has been mainly concerned with these [*i.e.* the mental] phenomena," suggests that he cannot really have read carefully what I have written. Throughout, I have emphasised the importance of the *physical* phenomena, not the mental, and it was Sir Bryan himself who, by his narrowing of the field to the mental phenomena, attempted to deprive me of my chief argument.

As regards the subject of *trance*, Sir Bryan and I are alike in not knowing what it is. The only difference in our attitudes, I take it, is that I consider it a phenomenon worthy of scientific study, whereas Sir Bryan does not. I wonder whether Sir Bryan considers the phenomenon of *sleep* to be worthy of scientific study, or whether he would take the stand of the physicists who (mostly, but not all) maintain that the only phenomena which science may properly take account of are those which can be always repeated accurately under given experimental conditions. If I put Sir Bryan to bed and tell him to go to sleep, can he always do so ? Is sleep any the less a fit subject for scientific study because it cannot be produced to order in an experiment ? Trance, if anything, is more amenable to such procedure than is sleep It is therefore undoubtedly a fit subject for scientific study. My complaint is that those who have the necessary knowledge and training refuse to become interested in these things ; they seem to think that the year 1926 marks the culmination of human knowledge in some way, and that there is nothing more to learn about life except on the purely mechanistic side. My whole article was really a protest against this view.

R. J. TILLYARD.

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Pall Mall, S.W.1.

Active Nitrogen.

FURTHER experiments have tended to confirm the work recently published by Dr. Rideal and myself upon the energy and nature of active nitrogen.

A study of the effect of the admission to the afterglow of a number of gases, elementary, compound, and mixed, shows that in no case so far examined does any chemical action resulting in the formation of definite compounds occur when the critical increment of the gas introduced exceeds *c.* 45,000-50,000 cal./gm. mol.

Experiments upon the action of active nitrogen upon the metals in the form of fine filaments show that catalytic decay takes place at their surfaces and in some cases (*e.g.* copper) is very marked. The efficiencies of the metals in this respect depend upon the stability of their nitrides. Calculations from the data obtained here again show that the energy of active nitrogen is *c.* 45,000 cal./gm. mol.

The decay of the afterglow has been measured by optical methods, and it has been found that the process is in all probability bimolecular with respect to the active nitrogen, but termolecular in reality since the total pressure appears to exert a marked influence, as suspected by Lord Rayleigh.

The line of reasoning adopted by Dr. Ludlam and Mr. Easson is sensibly the same as that of Saha and Sur. It is quite probable that an unstable compound such as N_2I_2 or a quasi-molecule of sorts is first formed when the iodine vapour is admitted to the afterglow, but is then broken up by collision with another molecule of active nitrogen, the energy liberated going to produce the line they mention. The nitrogen halides are notoriously unstable compounds and hence probably highly endothermic.

An alternative explanation is suggested by the presence of the β and γ bands in the spectrum of the afterglow. While the weight of evidence appears to be against their being really part of the true nitrogen afterglow bands, they invariably appear when the gas is purified in the usual manner. Since they extend at least so far as $\lambda 2154$, collisions between molecules of iodine and those of nitrogen or nitric oxide at this level may result in the appearance of the line in question.

This explanation could easily be tested by increasing the intensity of the β and γ bands, by the addition of oxygen, as in the recent experiments of Johnson and Jenkins (*Phil. Mag.* Sept. 1926) ; an increase in the strength of this iodine line should then follow. It is surely not at all legitimate to attempt an evaluation of the energy of active nitrogen from the spectral phenomena to be seen in the presence of such factors of totally unknown magnitude.

E. J. B. WILLEY.

Laboratory of Physical Chemistry,
Cambridge, October 27.

Liveing's Fire-damp Indicator.

SOME years ago I made frequent use of Mr. Liveing's very ingenious instrument, referred to in NATURE of October 30, p. 626, and I found its indications to be both accurate and excellent. The only drawback to its use in those days was the shaking which accompanied the turning of the handle to produce the glow, as this made accurate observation of the percentage of fire-damp somewhat difficult.

W. GALLOWAY.

17 Park Place, Cardiff,
October 30.

The Imaginary Roots of Equations.

PROF. C. RUNGE has informed me that the method I gave under the above title in NATURE of October 30, p. 627, has already been given by him in the " Encyclopädie der mathematischen Wissenschaften," vol. I. 1, p. 431. I need scarcely add that I was not aware that I had been anticipated when I sent my letter to NATURE.

H. C. POCKLINGTON.

6 Blenheim Crescent,
Leeds.

Reflex Regulation of Posture.[1]

By Dr. F. M. R. WALSHE.

TO those interested in the physiology of the nervous system, the history of our knowledge of the neuro-muscular mechanisms underlying posture must form one of the most fascinating chapters in the records of the science, and it is but fitting that any account of it should be prefaced by an expression of homage to Sir Charles Sherrington, to whose labours we owe the entire foundation of that knowledge.

Sherrington's investigations, in the course of which muscle tonus has been revealed as a purposive reflex reaction and the basis of all postural activity on the part of the musculature, are now thoroughly embodied in physiological thought and do not require detailed reference. It is of interest, however, when we recall the vicissitudes through which the term 'tonus' and our conceptions of muscle tone have passed to refer briefly to the experimental preparation which in the hands of Sherrington, and later in those of Magnus of Utrecht, has provided the key to the elucidation of those intricate neuro-muscular processes which underlie reflex posture. I refer to the decerebrate preparation. Prior to its discovery and description the nature, and even the very existence, of muscle tonus were subjects of conflicting opinion and observation. Numerous investigators had sought for this peculiarly elusive form of muscular activity in the single muscles of cold-blooded animals, and such glimpses of it as had been gained were too restricted in extent and too fugitive for any clue to its nature to be apparent. "To glimpse at the aim of a reflex," as Sherrington has remarked, "is to gain hints for further experimentation on it . . . the larger the muscular field involved in the reflex effect, the plainer usually its purpose."

The decerebrate cat is an animal in which the brain stem has been severed in the region of the tentorium, the section putting out of action all that part of the brain, including the forebrain, which lies anterior to the posterior corpora quadrigemina. Such a preparation may be called a ponto-spinal animal. Following this procedure, there appears an abnormally heightened tonus selectively distributed in those muscles which maintain the animal in its habitual standing posture—in other words, in the group of 'antigravity muscles.' This hypertonus has been called 'decerebrate rigidity,' and its intensity and characteristic incidence throughout the skeletal musculature have made possible a minute analysis not alone of the origin and nature of muscle tone, but also of its significance. Decerebrate rigidity is reflex standing. It will be apparent, therefore, that the discovery of this preparation opened a new and most fruitful era in the physiology of the nervous system.

Briefly, we have in muscle tone an enduring reflex muscular contraction of low intensity, endowed with a quality of plasticity in virtue of which the muscle can maintain a steady tension at varying muscle lengths, and readily overset transiently by intercurrent reflex reactions of phasic or movement type. It is a proprioceptive reaction, the stimulus arising in the muscle engaged in the reflex and consisting of those variations in tension produced by the voluntary motor activities of the animal (Sherrington and Liddell). It is believed that the tonic contraction is of the same nature, and is a function of the same elements in the striated muscle fibre as that seen in the muscle engaged in movement (phasic contraction), its peculiar qualities depending on the fact that now the elements respond in rotation, groups of individual muscles giving asynchronous series of responses.

In that beautiful analysis of reflex reaction which Sherrington has embodied in his book, "The Integrative Action of the Nervous System," he has pointed out that the skeletal musculature is controlled by two great reflex systems, which in the intact animal are in turn controlled by the cerebral cortex. Each system influences its own groups of the musculature, employing them in characteristic fashion. One system, the phasic system, is concerned with short-lived muscular movements and the arcs involved are predominantly spinal. The flexion reflex is a typical example in the group. The other, or tonic, system with which we are now concerned maintains and regulates that steady tonus or tonic contraction which is the basis, the raw material, of posture. Between the two systems there is a close and harmonious relationship, or, in Hughlings Jackson's apt phrase, "a perfect co-operation of antagonism." Every movement starts from and ends in a posture, and even the most superficial observation of some voluntary purposive movement betrays the existence of these two elements. For the effective performance of some movement of a limb it is essential that the organism as a whole should be oriented with reference to gravity and other external forces. The minute experimental analysis of muscular movement confirms this impression and has revealed the activity of the two systems mentioned above.

The tonic reflex system includes the autogenous reaction in the muscle which we call muscle tone, and also a complex series of controlling reactions by means of which tone is adapted to follow up the numerous and diverse movements made by the intact animal.

These regulating tonic reactions arise in the otolith organs of the labyrinths, in proprioceptive nerve endings in the muscles and tendons throughout wide regions of the body, and also in the nerve endings in the body wall which subserve the sense of pressure.

In 1909, as he relates, Magnus chanced to be working with a decerebrate preparation and noticed when he turned the animal from the lateral into the supine position that the extensor hypertonus of its limbs underwent an appreciable increase with the adoption by the limb of an attitude of more complete extension. Further, when the head was so flexed upon the trunk that the line of the mouth made an angle of 45° above the horizontal, an additional increase was seen to set in after a latent period of several seconds. These modifications of tone, and afterwards of limb posture, persisted so long as the new position of the head which had given rise to them was maintained.

[1] Opening paper of a discussion on "Reflex Posture" before Section I (Physiology) of the British Association at Oxford, August 9.

Simultaneously and independently, Sherrington observed that with the animal in a fixed position, rotation of the head to one side caused a similar increase of extensor tonus in the two limbs of the side to which the snout pointed. Extirpation of the labyrinths left the reaction intact, but division of certain cervical posterior roots abolished it. It therefore arose in proprioceptors in the neck musculature.

These observations formed the starting-point of Magnus's great work upon reflex posture, and have resulted in the discovery and classification of an extremely complex series of tonic reactions, which in sum make up the nervous mechanism by which normal postural activity is attained. In addition, Magnus has revealed the existence of a group of phasic reactions arising in the semicircular canals, and these with the tonic reflexes under discussion constitute the whole reflex mechanism of normal co-ordinated muscular activity.

Magnus and de Kleijn found that by imposing variations in the position of the animal's head in relation to the horizontal plane of space certain constant modifications of limb tonus, and therefore limb posture, could be produced. Further, after bilateral labyrinth destruction, variations of head posture in relation to the trunk also elicited certain other constant tonic reactions. These two groups are the so-called tonic labyrinthine and neck reflexes and together make up a group of 'standing reflexes.' By appropriate manipulation of the head by the observer, the animal can be made to take up a wide range of attitudes, corresponding to those habitually adopted by the animal during life. They found, however, that although it could stand, the decerebrate animal, if overturned, lay like a log and had no power of reflex control over the posture of its head. It was clear, therefore, that there must exist in the intact animal other tonic reactions governing head posture. Transection of the brain stem immediately anterior to the mid-brain led to the discovery of these other reactions. The mid-brain animal, for so such a preparation is called, does not exhibit hypertonus, but tone of normal intensity. It can stand, walk, and jump, and if overturned at once actively reassumes the normal sitting posture. If thrown from a height it lands upon its feet. The reactions by which these results are obtained are purely reflex, and the animal is a reflex automaton.

Further analysis of the preparation's activities has revealed the existence of a group of labyrinthine, neck and body 'righting reflexes,' in virtue of which the animal is able to maintain its head right side up in the world. This righting of the head sets in train secondarily all the other reactions by which the trunk and limbs are in turn brought into line with the head. Slow motion kinematograph photographs of the cat falling through space reveal the successive tonic and semicircular canal reflexes described by Magnus and his collaborators. First the head is righted, the anterior and the posterior portions of the trunk follow in turn, and finally, in virtue of phasic semicircular canal reactions, the limbs are outstretched so as adequately to receive the body weight as the animal reaches the ground. The ease and accuracy with which each of the various tonic and phasic reactions separately analysed by Magnus can be followed in such photographs are the most convincing demonstration of the minute accuracy of his observations.

In apes there is added to these labyrinthine and proprioceptive reactions a group of retinal righting reflexes of tonic character.

The reflex arcs of the various reactions we have been considering lie entirely within the limits of spinal cord and brain stem and do not pass through the cerebellum or basal ganglia. There is laid down, then, in the central nervous axis of the animal a mechanism which makes possible all the phasic and postural activities of the intact animal. By an automatic mechanism the animal is kept right side up in the world.

It is to observations made at the bedside by the clinician that we must turn to determine whether or not the laws governing the regulation of posture in a wide range of animal forms—from guinea-pig to ape—hold also for man. The evidence accumulated during the past fifteen years goes conclusively to show that they do.

Warned by the difficulties which the pioneer investigators met with in their animal experiments, the clinician has sought for a form of hypertonus resembling experimentally produced decerebrate rigidity. The student of nervous diseases is familiar with several forms of tonic muscular contraction of considerable intensity, but all except one of these may readily be dismissed as bearing no resemblance to the condition in question. It might be thought that in man a condition of decerebration is not compatible with continued existence, and indeed complete bilateral decerebrate rigidity is one of the rarest observed phenomena. We have, however, in the hypertonus, or spasticity, of the residual hemiplegia left after a cerebral hæmorrhage or softening, a unilateral state of tonic muscular spasm in the limb muscles which is manifestly qualitatively identical with decerebrate rigidity. It arises as a proprioceptive reflex in the muscle concerned, and destruction of the muscle's afferent nerve supply abolishes it. It is plastic, and easily overturned by the same phasic reflexes as have this effect in the animal. It may persist undiminished for years. It has a selective incidence in the limb musculature: in the extensor, or antigravity, muscles of the legs, but in the flexors of the arms. This altered incidence in the upper limbs of man is related to the profoundly altered functions of the fore limbs in this erect animal, and the reasons for so thinking need not now concern us. Further, it has recently been shown that the tonic neck and labyrinthine reflexes of Magnus and de Kleijn may be present in these rigid and paralysed limbs, following the same rules which govern their occurrence and form in the decerebrate animal.

In addition it has been possible to recognise in a very familiar clinical phenomenon the existence of another group of tonic reflexes, arising in the proprioceptors of the normal limb and acting upon the paralysed limbs. It has long been known, and every hemiplegic subject soon discovers the fact for himself, that when with the normal arm the subject makes some forceful, tonically sustained, voluntary movement, the contralateral paralysed limb goes into strong tonic

spasm and takes up a new attitude, which is sustained for so long as the voluntary muscular act evoking it. The form, latency, and duration of this so-called 'associated movement' shows it to be a tonic reflex of the same type as those described by Magnus. Further, in favourable cases, a beautiful interaction between labyrinthine, neck and limb reactions may be observed if we combine changes in the position of the subject's head both in relation to space and to his trunk.

It is clear, in short, that the tonic reactions of Sherrington and of Magnus are present in the human subject. In a single personally observed case of complete decerebrate rigidity in the human subject, in which physiological 'decerebration' was performed by a tumour compressing the mid-brain, a perfect decerebrate rigidity with tonic neck reflexes and phasic flexion and crossed extension reflexes were obtainable.

These observations upon the subjects of disease and injury of the nervous system are of a double interest. They serve to correlate the work of the experimental physiologist with that of the clinical observer, they bring the human subject into line with animals lower in the scale. Further, they illustrate the value to the clinician of experimental physiology. For many years the labours of clinical neurologists have accumulated a vast mass of 'physical signs' of disease, which have been used empirically as aids to diagnosis; but so far as possessing other meaning was concerned they remained like the jumbled pieces of a mosaic. Thanks to the light received from the physiological laboratory, it is now possible to piece them together into a coherent and intelligible pattern, and they have become manifestations of a dissolution of nervous function, pregnant with physiological significance. Thus may the clinician not only derive information of inestimable value to him in his analysis of the phenomena of disease, but he may also, in a measure, repay some of his debt to the physiologist by carrying over the latter's animal observations to man.

Some Recent Advances in Astrophysics.[1]

By Prof. E. A. MILNE, F.R.S.

OF late years astronomers have become increasingly despairing as to what the stars are doing—in what direction they are evolving, how they produce the energy they radiate, whether (and if so why) some of them pulsate, how the stars are born and whether they die. At the same time astronomers have become increasingly confident as to what the stars are really like. It is proposed here to deal briefly with one province of this less speculative side of astrophysics, namely, that which is described, broadly speaking, as the subject of stellar temperatures and stellar spectra.

What are called the 'effective temperatures' of the stars have been determined by measurement of their colour, much in the same way as the temperature of a piece of red-hot iron may be estimated from its colour. With the piece of iron, we may measure either the total radiation leaving each square centimetre of its surface, or the ratio of the intensities of radiation for two different constituents of its spectrum. From either of these measurements we may infer the other. Both types of measurement are possible for the sun, and by the work of Abbot, Plaskett, and Fabry and Buisson, they have been shown to be in general agreement. For the stars in general, only the colour type of measurement is possible. It is true that of recent years the heat radiated by the stars has been measured directly, but such measures by themselves yield no more information than a determination of apparent magnitude. Colour-measures, however, by the use of Planck's law, yield the amount of radiation leaving each square centimetre of the star's surface—a quantity expressed parametrically by the effective temperature, or surface brightness.

The importance of this quantity lies in the fact that the total radiation leaving the surface per second is precisely the amount generated in the interior per second, assuming a quasi-steady state. Two examples of its employment in fundamental calculations may be mentioned. The amount of light from a star (a quantity given by the apparent magnitude) reaching the earth is equal to the product of the surface brightness into the solid angle subtended by the star. Hence a determination of surface brightness plus one of apparent magnitude is equivalent to a determination of the angular diameter of the star as seen in the sky from the earth. The confirmation of such estimates by the direct measurement of angular diameters at Mount Wilson by means of the Michelson interferometer affords a useful check on one of the steps in the reasoning, namely, the deduction of radiation per unit area per second from an observation of colour. The second example is that of the estimate of the densities of the components of a double star. The density-ratio of the components may be readily calculated in terms of the ratio of the surface brightnesses, the mass-ratio, and the difference of the apparent magnitudes. In this way it was inferred that the companion of Sirius must have a density some 60,000–70,000 times that of Sirius itself, and the verification of this by Adams at Mount Wilson, by measurements of the Einstein shift in the lines of the spectrum, has been one of the most sensational scientific events of the past year.

The effective temperature, however, is not the temperature of any particular portion of the star. The question arises, Is there any method of determining the actual temperature in the surface regions of a star, which alone we can directly observe? Have we a thermometer? The answer is in the affirmative. We can use the atoms volatilised in the atmosphere of a star as their own thermometer, by observing the absorption spectrum they produce.

The theory depends on the recent progress in atomic physics. It has long been known that the spectra of the great majority of stars fall into a single linear sequence, in which, as we pass by ascending effective temperatures from the red stars to the blue stars, some lines decrease in intensity, others increase, attain a maximum and decrease, others again only appear far on

[1] Substance of a lecture delivered before the Manchester Literary and Philosophical Society on October 19.

in the sequence. Such a linear array of spectra could scarcely be due to differences in chemical composition, and it was emphasised by Russell and others that in some way the ordered sequence of spectra must be related to the sequence in effective temperatures. The true explanation, however, was only discovered in 1920, by Saha.

It was Saha who first pointed out that at high temperatures the atoms composing stellar atmospheres must dissociate into ions and free electrons according to the same laws of thermodynamics used by chemists to calculate molecular dissociations. Given the ionisation potentials of the atoms, the degree of dissociation is a function of temperature and pressure—to be precise, the partial pressure of the free electrons—and for a given pressure the ionisation increases with the increasing temperature. Consequently, for each element we shall have first the spectrum of the neutral atom, then that of the once-ionised atom, followed in turn by that of the twice-ionised atom, and so on. At the highest temperatures the spectrum of the neutral atom should completely disappear, in general. Further, the absence of an element from a stellar spectrum does not necessarily mean the absence of the element from the stellar atmosphere. It may only mean that the lines it is capable of producing in its then stage of ionisation are outside the accessible range of spectrum.

It is necessary to distinguish the ultimate lines of an atom in any given stage of ionisation from the remaining lines. The ultimate lines are absorbed only by the atom or ion in its normal, or unexcited stage. The theory shows immediately that the ultimate lines of a neutral atom should steadily decrease in intensity with increasing temperature: the ultimate lines of an ionised atom should increase at first, slowly attain a maximum and then decrease as further ionisation ensues. Calcium provides an illustration of both types of lines.

Intermediate between successive stages of ionisation we have atoms in excited states, with corresponding absorption spectra. Only a minute fraction of the atoms are in any given excited state at any instant, but the fraction is a definite one given the temperature and pressure, on the assumption of thermodynamic equilibrium. Moreover, this fraction has a comparatively sharp maximum. It is easy to see that a maximum must occur. At lower temperatures, comparatively few of the atoms are excited. As the temperature increases the excited fraction of atoms in the given state of ionisation increases, but the total number of atoms in the given state decreases owing to the next stage of ionisation setting in, and ultimately all the atoms pass into the next stage of ionisation. The number of excited atoms is thus practically zero at both low and high temperatures. In between it must have a maximum.

Following the method of Saha, it has been found possible to calculate at what temperature such a maximum should occur. We then identify the maximum in the number of excited atoms with the observed maximum of the corresponding absorption lines in the stellar sequence. We thus arrive at a truly thermometric scale of stellar temperatures. The most recent and detailed comparisons of observed and theoretical maxima are those contained in the researches of Miss Payne, of the Harvard College Observatory, and the following is her table of temperatures.

Class.	Temperature.	Class.	Temperature.
K_5	3,000°	A_0	10,000°
K_0	4,000°	B_8	13,000°
G_0	5,000°	B_3	17,000°
F_0	7,500°	$B_{1\cdot5}$	18,000°
A_5	9,000°	B_0	20,000°

At present there still remains an empirical element in the temperature scale. It is necessary to assume a value for the pressure—the partial electron pressure—in stellar atmospheres, and to assume that the pressure is the same in all stars. The removal of this empiricism promises to open up a still more important line of work. A synthetic theory of the structure of a stellar atmosphere would not in fact deal with the pressure at any particular level. Starting with the value of gravity at the surface of the star, and the atomic absorption coefficients, it would proceed to calculate the distribution of atoms through the atmosphere, taking due account of the varying effects of selective radiation pressure on the individual atoms. Ultimate lines, for example, will give rise to much more intense radiation pressure than lines corresponding to excited states. Different classes of atoms will thus be at different horizons in the atmosphere, and so at different pressures. The nature of the spectrum itself controls the pressure, and so in turn the degree of ionisation. This double relatedness of spectra to ionisation, due to the intervention of radiation pressure, may lead after further study of stellar spectra not only to an improved temperature scale with the empiricism removed, but further to determinations of surface gravity and to astrophysical determinations of relative, perhaps even absolute, atomic absorption coefficients. The possibility of the latter type of determination serves to remind us that astrophysics contributes to atomic physics as well as borrows from it.

A further by-product of the theory is the determination of the relative abundances of the different elements in stellar atmospheres. Observations of maxima provide temperatures, and are independent of relative abundances: each maximum is a thing *per se*. But the places of first or last appearance of a line in the stellar sequence depend on the amount of the corresponding element available, and in the hands of Miss Payne have been used to estimate the relative abundances. It must suffice to state that the abundances bear a relation of rough similarity to the abundances of the same elements in the crust of the earth, with the exception of hydrogen and helium, the behaviour of which is anomalous.

It has already been mentioned that intensities of spectral lines are connected with the surface values of gravity. Empirical connexions of line-intensities with the absolute luminosities of the corresponding stars are now well known: they are another aspect of the same phenomenon. By a method originated by Kohlschütter, Adams and Joy, they are now used at many observatories to determine the parallaxes of stars spectroscopically. In conclusion, reference may be made to a similar method recently developed in the brilliant work of Ch'ing-Sung Yü at the Lick Observatory. He has investigated the continuous absorption spectrum associated with the limit of the Balmer series

of hydrogen. This spectrum is produced by the ionisation of hydrogen atoms: its intensity is a measure of the fraction of hydrogen atoms remaining un-ionised. Yü has found empirically that it is a function of colour-temperature and of absolute magnitude. The method eliminates one unsatisfactory feature in the method of Adams and Joy, namely, the use of different empirical reduction curves for stars of different types. Yü's photometric measures determine colour-temperature and hydrogen absorption from the same spectrogram, and from these two quantities the absolute magnitude may be inferred. It is too early to estimate the ultimate value of the method, but it is at once a new weapon for the determination of parallaxes by calibration on known stars, and a challenge to theoretical investigators.

Obituary.

PROF. W. J. HUSSEY.

PROF. W. J. HUSSEY died suddenly in London on Thursday, October 28. He reached England on October 23 with Mrs. Hussey and with Mr. and Mrs. Rossiter. They proposed to leave for the Cape on October 29, taking with them a large telescope of 27 inches aperture and 41 feet focus. This was to be installed near Bloemfontein, Prof. Hussey remaining until the building was completed and leaving Mr. Rossiter in charge to carry out an extensive programme of double star observations. Prof. Hussey had only lately recovered from an attack of pleurisy, but seemed fairly well on October 27, when he gave an address to the British Astronomical Association.

William Joseph Hussey was born at Mendon, Ohio, on August 10, 1862, and graduated B.S. of the University of Michigan in 1889. For some years he taught mathematics in the University of Michigan, and was acting director of the Detroit Observatory. In 1892 he was appointed assistant professor of astronomy at the Leland Stanford Junior University, afterwards succeeding to the chair. From Leland Stanford it was a natural transition to the post of assistant astronomer in the Lick Observatory, not many miles away.

Hussey's knowledge and enthusiasm were such as to enhance the high traditions of this famous observatory. Barnard and Burnham had left, and their places were filled by Aitken and Hussey. The first important work Hussey undertook was the re-observation and discussion of the double stars observed by Otto Struve. The results form vol. 5 of the Lick Observatory publications. Hussey measured many close and difficult double stars which were only within reach of the largest telescopes. Among them may be instanced δ Equulei, which has an elliptic orbit, and the two stars are only separable when near elongation. He followed this star closely and found it to have a period of 5·7 years, one of the shortest known, while previous observers had supposed the period to be about double this length. It may be interesting to note that he determined the parallax of this star by a combination of line of sight determinations of linear velocity with the determinations of angular movement resulting from double star measures.

In 1899 Hussey joined Aitken in a systematic examination of all stars between the pole and $-22°$ down to $9·0^m$ or $9·1^m$ to discover which of them were double. They worked on this programme from sunset to sunrise, and when Hussey left in 1906 to be professor of astronomy and director of the observatory of the University of Michigan, he had discovered so many as 1327 new double stars. Here he was engaged in spectroscopic work and in building and organising a new observatory. In 1911 the directorship of the observatory of La Plata was added to that of the University of Michigan. Before his resignation of this post in 1917, he had discovered 312 new southern double stars.

In 1902 Hussey was appointed to make telescopic tests of the suitability of sites in South California and Arizona for a solar observatory, and strongly advocated the selection of Mount Wilson. From 1917 he had in mind the possibility of the establishment of an observatory in the southern hemisphere specially for double star work. Three years ago he visited South Africa, and was very favourably impressed with the site of Bloemfontein. A personal friend from college days, Mr. Lamont, has recently provided funds for a telescope, designed and built under Hussey's direction, with an object-glass by Zeiss. This telescope was completed and was being taken to Bloemfontein at the time of Prof. Hussey's death. We understand that arrangements have been made to go forward with the establishment of this observatory, and that Mr. Rossiter left for South Africa on November 5. This, we may be sure, would have been in accordance with Prof. Hussey's wishes.

Prof. Hussey had many friends among English astronomers, who admired his gifts of industry and enterprise, and were always pleased when occasions like eclipse or other expeditions brought him to London and gave an opportunity of meeting him. He had been a foreign associate of the Royal Astronomical Society since 1903.

F. W. D.

WE regret to announce the following deaths:

Prof. F. M. Caird, emeritus professor of clinical surgery in the University of Edinburgh and a past president of the Royal College of Surgeons of Edinburgh, who worked as a student under Lister, on November 1, aged seventy-three years.

Dr. W Romaine Newbold, Seybert professor of moral philosophy in the University of Pennsylvania, who wrote on suggestibility, automatism and kindred phenomena, on September 26, aged sixty years

Dr Francis E. Nipher, emeritus professor of physics in Washington University, St. Louis, whose work covered aspects of gravitating nebulæ, wind pressure, and the electric discharge, on October 6, aged seventy-eight years.

Dr. Franz Pfaff, formerly professor of pharmacology and therapeutics at the Medical School of Harvard University, on September 26, aged sixty-six years.

Dr. C A. Waldo, emeritus professor of mathematics in Washington University, St. Louis, known for his work on warped surfaces, on October 1, aged seventy-four years.

News and Views.

On Saturday, November 27, the authorities of the town and cathedral of St. Albans will commemorate the six hundredth anniversary of the election of a prelate famous in the history of the Abbey—Richard of Wallingford, Abbot 1326–1335. This fact has interest for men of science and archæologists, for Wallingford was a scientific pioneer, as well as a distinguished abbot. At Oxford, where he was a student and doctor in the 'Hall' maintained by the leading Benedictine houses for the reception of promising youths from their local schools, he won fame as a mechanician and astronomer, almost as a magician. In this he shared the lot of 'Friar Bacon,' whose follower, though not immediate pupil, he was; it seems that that pioneer genius started what might have been a great school of science at the university. Wallingford was the author of scientific treatises, one of which, "The Rectangulus," survives in MS. to this day. Many of the scientific instruments he invented are preserved, either actually or as reproductions, in the Ashmolean Museum, and were the basis on which later men could work. His scientific *chef d'œuvre*, however, was the astronomical device 'Albion' ('all by one'), which showed "the action of the tides and the revolutions of the planets."

The above commemoration will be attended by Sir Frank Dyson (the Astronomer Royal), Prof. H. H. Turner, Dr. R. T. Gunther, and other scientific men (including representatives of the Clockmakers' Company), and will take the form of a service in the Abbey of St. Albans at 4 P.M., at which a wreath will be placed on Wallingford's tomb, and his prayers used. Later, there will be a gathering in the Town Hall, when papers will be read on Wallingford's work as man of science and abbot, and there will be a small exhibition of his scientific instruments. It is hoped that this will include the actual instrument 'Albion,' for it was acquired from the Royal Commissioners at the time of the dissolution of the abbey, by a local 'Squire,' and it has ever since been an heirloom in his family. The instruments will be explained by Dr. Gunther. The service and gathering are, naturally, public, and any one desiring more information on the matter should apply to the Hon. Secretary, Wallingford Commemoration, Kingsbury Knoll, Verulam Road, St. Albans.

According to a recent message of the Stockholm correspondent of the *Times*, the following awards of Nobel prizes have been made: The reserved prize for physics for 1925 between Prof. J. Franck of Gottingen and Prof. Hertz of Halle; the prize for physics for 1926 to Prof. Jean Perrin; the prize for chemistry for 1925 to Prof. Richard Zsigmondy, the prize for chemistry for 1926 to Prof. The Svedberg. Prof. Franck is professor of physics and director of the physical laboratory in the University of Göttingen and is the author of many papers on atomic structure, ionisation by collision, and related topics. Prof. Perrin is professor of physical chemistry at the Sorbonne; he is the author of a standard work on atomic chemistry which has passed through many editions and has been translated into French and German. He was elected a foreign member of the Royal Society in 1918. Profs. Zsigmondy and Svedberg are both best known for their work on the colloidal state. Prof. Zsigmondy is professor of inorganic chemistry in the University of Göttingen; he has worked largely on the gold sols, and his book on colloids and the ultra-microscope has been translated into English. A recent volume, "Das Kolloide Gold," by Prof. Zsigmondy and P. A. Thiessen, is the first of a new series of monographs in which the scattered work on the physics and chemistry of colloids is being brought together under Prof. Zsigmondy's guidance. Prof. Svedberg, professor of physical chemistry at the University of Upsala, has carried out numerous and fundamental researches on colloidal solutions of the suspensoid type and has made noteworthy contributions to our knowledge of the chemistry of photographic processes.

At a luncheon given on November 12 by the Imperial College of Tropical Agriculture to the Dominion Prime Ministers and representatives, Mr. Amery made the important announcement that 96,000*l*. out of the 100,000*l*. which Lord Milner set out to obtain as an endowment fund for the College has now been raised. Sir Arthur Shipley, who presided, pointed out the great need there is for agriculturists who have been thoroughly trained in tropical agriculture; men of this type are wanted everywhere, and it is this want that the Trinidad College is hoping gradually to satisfy One of the difficulties is that there is not at present a sufficient supply of schoolboys with any biological training. Sir Arthur deplored the fact that it is now possible for a student to take honours in a Natural Science Tripos at Cambridge without taking at least one biological subject. At the present moment the market for chemists and engineers is gravely overstocked, whereas there is an appalling dearth of entomologists and mycologists. This state of affairs the College is endeavouring to redress. Both Mr. Bruce, the Prime Minister of Australia, and Mr. Coates, the Prime Minister of New Zealand, stated that they took the greatest interest in the College, although neither was able to make any immediate promise to provide funds for its enlargement.

It is doubtless true that the number of fatal flying accidents to service flying officers this year—more than seventy to date—large as it is, is in diminishing ratio to the number of hours flown as compared with previous years since the War. It is probably true also that many of the accidents which occur are due to errors of judgment on the part of the pilots. The number of accidents is sufficiently large, however, to occasion concern and to re-emphasise the need for more and more research in connexion with the design and construction of aircraft, and obviously for the exercise of more care in the selection of pilots and more care in their training. Whether the private aircraft construction companies should be granted subsidies with which to carry out their own research programmes, the suggestion made by Mr. Handley Page

in his letter published in the *Times* on November 12, or whether it would be better for the Royal Aircraft Establishment to undertake aircraft construction as well as design, is a debatable question. It is obvious that Great Britain, however favourably it compares with other countries as regards accidents, has still to carry out much research work before a type of aircraft is evolved which will combine stability with manœuvring capacity. There is still much work to be done in connexion with the elimination of the possibility of fire on 'crashing,' and other safety precautions There is little doubt that every aeroplane accident whether it is a service machine or a commercia machine involved, shakes the confidence of potentia passengers in the safety of air travel and reacts unfavourably against the development of commercial air services.

ON November 23, the centenary occurs of the death of Johann Elert Bode, the famous German astronomer. Born at a time when scientific studies in Germany were recovering from the set-back brought about by the disastrous Thirty Years' War, Bode was the first to diffuse a general taste for astronomy among his fellow-countrymen. He was the Lalande of Germany, and his name is known to every one as the author of "Bode's Law." That law, it is true, is to be found in the writings of Titius, Wolf, and others, but it was Bode who first directed attention to it. His world-wide reputation, however, rested on other grounds. The son of a schoolmaster, and born in Hamburg, January 19, 1747, Bode at the age of twenty-one years published a popular treatise on astronomy and an essay on the transit of Venus of 1769. Three years later Frederick the Great made him astronomer to the Berlin Academy of Sciences, in which position he did much to stimulate astronomical studies. His well-known "Astronomische Jahrbücher" were commenced in 1774; two years later he published an essay on the constitution of the sun, and in 1778 made known the law bearing his name. He closely followed Herschel's newly discovered planet, and it was he who named it Uranus when Herschel would have called it Georgium Sidus. His "Uranographia," or Great Celestial Atlas, appeared in 1807 and contained observations of about 17,000 stars. Long regarded as the head of German astronomers, he was younger than Mayer, but among his contemporaries were such as Harding, Gauss, Schumacher, Struve, and Encke.

THE opinion among engineers of the value of a training in the scientific principles of the profession has altered greatly during the past twenty years, and there are few, even among the older school of engineers, who do not now recognise the advantages of such a training. But although few subjects have been more widely discussed, there are still wide differences of opinion as to how, when, and where such a training is best obtained, and as to exactly what it should include. Should it be obtained at a technical school in evening classes, or in a full-time course at a university? Should it precede, be carried on simultaneously with, or follow a course of practical training in works or office? Should the university attempt anything in the nature of practical training? How long should the period of practical training last? In a paper read at a meeting of the North-East Coast Institution of Engineers and Shipbuilders on October 29, Principal Sir Theodore Morison, of Armstrong College, Newcastle, suggested the formation of a committee of the Institution with the view of giving an authoritative answer to these and other cognate questions.

THE outcome of Sir Theodore Morison's suggestion will be of interest, and we look forward to a report of the discussion of the paper. Numerous committees of engineers have considered the subject in the past in Great Britain and other countries, without by any means exhausting its possibilities. Since the report of the committee of the Institution of Civil Engineers on engineering education some years ago, the scope of engineering has in many respects changed, and the ideal scheme of fifteen years ago is not of necessity best fitted to satisfy to-day's requirements. Such a committee has recently been considering the subject in the United States of America. Perhaps the most interesting part of its report is the general insistence on the importance of cultural subjects, and of a thorough grounding in the general physical principles of engineering. The idea of specialising until a late period of the course, and even then of too pronounced specialisation, is in general deprecated. We are of the opinion that this is a very sound view. We believe that the majority of the engineering schools of the universities of Great Britain do aim at giving this sound fundamental training. At the same time, provision should be made at certain selected universities for highly specialised courses of post-graduate standing. At the moment, this would appear to be the weakest part of the university training of engineers in England. Such a committee as the one suggested might well consider what courses of this nature might most usefully be instituted.

IT seems probable that in the immediate future the development of electricity supply in Ireland will rapidly increase. At present it is more backward in this respect than any country in Europe. The consumption in Northern Ireland is 43 units per head of the population, and in the Free State only 16 units per head. This compares with a consumption of 2500 units in Norway, 900 in Switzerland, and 140 in Britain. In his presidential address to the Irish section of the Institution of Electrical Engineers, Mr. Kettle, the city electrical engineer to Dublin, took a favourable view of the future of electricity supply in Ireland. He said that the Shannon scheme is not mainly a 'power' scheme. It is more a 'transmission' scheme comparable to the Swiss Central Board arrangement and the British Government scheme. He admitted, however, that the promoters of the Shannon scheme seem to anticipate that it will be a commercial success from its commencement—an altogether too sanguine view to adopt. The Free State has anticipated the ordinary course of events

by about ten years, but having put its hand to the plough it cannot turn back. The country has been definitely committed to the scheme, and the fullest co-operation with other schemes is necessary in order to make it a success. A second Shannon Power Bill is apparently expected in the near future and it will probably deal with the supply and control of the entire electricity supply of the Irish Free State. A transmission scheme has been outlined for Northern Ireland, but the authorities there appear to be disposed to proceed more gradually than those of the Free State. There is not much difference between the two schemes except that one would use coal and the other water power. Mr. Kettle thinks that both networks should be so designed that they can be combined to form an all-Ireland scheme at a future date.

THE story of Clerk Maxwell has hitherto been mainly confined to biographical details of his life and general career. As, however, it is now nearly fifty years since he died, it is possible to see how much his work has influenced the development not only of physics but also of applied engineering. In particular, every radio expert claims him as one of the great pioneers of electrical communication because of the invaluable help his electromagnetic theory of light has been in the development of their art. In the October issue of *Electrical Communication* Mr. Rollo Appleyard begins a series of articles on the pioneers of electrical communication by an eloquent eulogy of Maxwell. In 1856 Maxwell accepted a professorship at Aberdeen. In 1860 he became a professor at King's College, London, and in 1871 he became professor of experimental physics at the Cavendish Laboratory, Cambridge. It has to be remembered that from 1851 to 1865 very rapid progress had been made in submarine telegraphy, and many data in connexion with electrical phenomena had been collected which Maxwell had to interpret from the theoretical point of view. His great paper on the "Dynamical Theory of the Electromagnetic Field" was published in 1865. On this paper the electrician has built his practical theory of the working of the alternating current transformer and much of the modern theory of electrical communication. Maxwell admitted electricity to the rank of a physical quantity, but he warned us against assuming too hastily that it was either matter or a form of energy. He considered that it was proved that electricity could not be annihilated and that it could not be created. He has left us a memory of individual thought and achievement which has rarely been rivalled in the history of the world.

PROF. A. P. LAURIE delivered a lecture to the students of the Royal Academy, London, on Wednesday, November 10, on "The Theory of Colour and its Application to Painting." Modern pictures in oil vary frequently and lower considerably in tone in the course of years. One cause of this is the yellowing of the oil, and an investigation was undertaken to see whether some other cause was not also present. Pigments may be regarded as translucent particles of varying refractive index, and the light received from their surface will consist partly of light reflected from the first surface struck by the ray of light, and partly by light transmitted through the pigment, and then reflected. The first reflection will consist principally of white light. The ratio between the reflected and the transmitted ray varies according to a somewhat complex formula with the difference between the refractive index of the medium in which the pigment is ground and that of the pigment itself. Thus, if the refractive index of a linseed-oil film increases with age, the result will be gradually to lower the tone of the pigment ground in it. Experiments have shown that in nine months the change is sufficient to affect the opacity of white lead and the tint of cadmium yellow. A rough table was then prepared of the principal bright pigments used by artists, these pigments being arranged in the order of transparency by examination in media of higher and higher refractive index and also in their spectrum order, so as to enable artists to pick out those least affected by the two changes taking place in linseed oil. These experiments throw new light on the methods of oil painting in the fifteenth and sixteenth centuries; the painters of that time were evidently experimentally aware of both of these properties of linseed oil and based their technique upon these facts with the view of keeping up the colour key of their pictures.

THE thirteenth Thomas Hawksley Lecture was delivered at the Institution of Mechanical Engineers on November 5 by Prof. E. G. Coker, the subject chosen by the lecturer being "Elasticity and Plasticity." After a brief historical introduction, Prof. Coker described the advances which have been made in recent years in the science and technique of photo-elasticity. An interesting feature of this part of the lecture was the description of the apparatus now used for measuring the applied load, which depends upon the elastic deformation of a steel ring loaded diametrally. Photo-elastic methods are employed to determine the most suitable form of ring, and a mechanical multiplying device fixed within the ring serves to record visually the diametral extensions. Prof. Coker then outlined the mathematical theory of photo-elasticity, in regard to the determination of the principal stresses both by direct measurement of the lateral strains, and by Filon's development of Clerk Maxwell's method of integration along the lines of principal stress, using as an illustration of the latter the dovetailed joint used for steam turbine blades. Dealing next with the subject of elastic breakdown, Prof. Coker described the various attempts which have been made to discover a law governing failure under all systems of stress, and referred particularly to those involving combinations of the single criteria proposed by Rankine, St. Venant, and Guest, and to the strain energy theory of Haigh and its modification by von Mises. A most interesting portion of the lecture was devoted to the subject of plasticity, the researches of Prandtl, Hencky, and Nadai being brought under review, particularly in their application to the phenomena associated with the pressure of a die in a steel plate. The manner in which the soap film method used by

Griffiths and Taylor for the determination of stress distribution in torsion can be extended to the case of plastic strain was described, and the lecture concluded with a review of the present state of knowledge regarding the application of optical methods to the determination of plastic stresses.

MR. P. A. BUXTON, of the London School of Tropical Medicine, to whose researches in the New Hebrides reference was made in the article on West African Development which appeared in NATURE of November 6, writes to correct a rather important misapprehension of his conclusions regarding the relation between malaria and abortion. In commenting on the omission in Mr. Ormsby Gore's report of any reference to Mr. Buxton's important memoir on "The Depopulation of the New Hebrides," the statement was made that "it seems fairly well established from the recent researches of Mr. Buxton in Melanesia that malaria is one of the principal determining causes of abortion and still-births" This was based on the statements on page 425, vol. 19, *Trans. Roy. Soc. Trop. Med. Hyg.*, to the effect that "abortion is common in all the islands of Melanesia"; the probability "that methods of obtaining abortion, which have been known [to the natives] from time immemorial, have been used more and more frequently within the last half-century," partly due to increasing monogamy, the outcome of the white missionary's zeal; and the supposition "that unprovoked abortion is common in the New Hebrides, owing to the malaria, and therefore any procedure which is adopted to produce abortion will occasionally be followed by the desired result, even if it is intrinsically harmless." Too much has been read into this last statement, for Mr. Buxton writes: "My conclusions may be summarised thus: malaria and the practice of abortion (not abortion caused by malaria) are both concerned in the disappearance of these peoples. But I have never showed, or tried to show, that malaria caused enough abortions to make it a factor in the depopulation, and it seems improbable that this is so, for the depopulation is an event of the last century and the malaria is an indigenous disease.'

REFERRING to our note in the issue of November 13, p. 708, on the distances at which the 'concentration shoot' off Portland on October 30 was heard, Prof. A. E. Boycott writes stating that the firing was heard very clearly in the open near Aldenham, Hertfordshire, about 125 miles from Portland, and was mistaken at first for thunder There was a fairly strong north wind blowing. Dr. R. T. Gunther, 5 Folly Bridge, Oxford, states that the firing was distinctly heard on the towing-path near Oxford and it also caused the windows of his house to rattle. Oxford is about 110 miles from Portland.

IN the issue of *Science* for October 1 there is a short but interesting contribution from Dr. Edgar F. Smith on Priestley's life in America, whence he withdrew in 1794 from the animosity to which his religious views had given rise in England. Priestley's daily life in his adopted home is briefly described, and his manifold activities summarised. Persecution followed him across the Atlantic, mainly on account of the anonymous attacks on him which are stated to have been written by William Cobbett, "an Englishman whose pen, dipped in gall, spared the venerable scientist in no wise." He was, however, a friend of American divines. Priestley's advanced views on education are compared with those of Herbert Spencer, and the article is a sympathetic account of a man who has not, perhaps, had the credit paid to him which is his due.

IT is announced in *Science* that the John Fritz Gold Medal of the American Societies of Civil, Mining and Metallurgical, Mechanical and Electrical Engineers for 1927 has been awarded to Elmer Ambrose Sperry, of New York, for the development of the gyrocompass and the application of the gyroscope to the stabilisation of ships and aeroplanes.

AT the annual general meeting of the Cambridge Philosophical Society, the following officers were elected for the session 1926-27: *President*, Dr. H. Lamb; *Vice-Presidents*, Mr. G. Udny Yule, Prof. J. T. Wilson, Prof. A. Hutchinson; *Treasurer*, Mr. F. A. Potts; *Secretaries*, Mr. F. P. White, Mr. R. H. Fowler, Mr. H. Munro Fox; *New Members of Council*, Prof. T. M. Lowry, Dr. H. Jeffreys, Dr. F. J. W. Roughton, Mr. F. T. Brooks.

IT is now announced that the Proceedings of the Optical Convention, 1926, held at the Imperial College of Science and Technology, South Kensington, on April 12 17 last, will be ready in the first week of December. The book is in two cloth-bound and fully illustrated quarto volumes, each of more than 500 pages, and contains the presidential address and the papers read at the Convention, with a full report of the discussions thereon. The address of the Secretary of the Optical Convention is 1 Lowther Gardens, Exhibition Road, London, S.W.7.

A NATIONAL Coal Products, Chemical, and Engineering Exhibition, arranged by the Manchester Section of the Society of Chemical Industry with the assistance of Provincial Exhibitions, Ltd., was opened at the City Hall, Manchester, on November 16 and will remain open until November 27. Scientific exhibits have been obtained from the fuel departments of the universities of the north of England, from the Fuel Research Board, and from the Lancashire and Cheshire Coal Research Association, and there are models, diagrams, and photographs of special interest to those engaged in the mining and utilisation of coal. In connexion with the Exhibition, a Conference on Tar will be held on November 26; three sessions have been arranged, the chairmen of which are Prof. A. Smithells, chairman of the Fuel Section of the Society of Chemical Industry; Mr. T. Glover, president of the Institution of Gas Engineers; and Mr. E. Escott Wood, president of the Coke Oven Managers' Association.

THE Smithsonian Institution of Washington announces the dispatch of a botanical exploring expedition to Colombia under the leadership of Mr. E. P. Killip. Starting from Cartagena, the expedition will follow the valley of the Magdalena River to

Puerto Vilches and then cross over to Bucaramanga and Pamplona near the Venezuelan frontier. The expedition forms part of the programme decided on in 1917 by the Smithsonian Institution, the New York Botanical Garden, and the University of Harvard, for the systematic exploration of the four north-western states of South America, and continues the work begun in 1922 by Mr. Killip in the country around Buenaventura.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—Two laboratory assistants at the Low Temperature Research Station, Cambridge—The Superintendent, Low Temperature Research Station, Downing Street, Cambridge (November 27). An assistant in mycology in the Pathological Laboratory, Harpenden, of the Ministry of Agriculture and Fisheries—The Secretary to the Ministry, 10 Whitehall Place, S.W.1 (November 29). A lecturer in chemistry at Armstrong College, Newcastle-upon-Tyne—The Registrar (December 1). Chemists, physical chemists and physicists for work under the Research Association of British Paint, Colour and Varnish Manufacturers—The Director of the Association, 8 St. Martin's Place, W.C.2 (December 2). An assistant lecturer in organic chemistry in the University of Leeds—The Registrar (December 6). A demonstrator in mathematics at the Royal College of Science, South Kensington—The Secretary, Imperial College of Science and Technology, South Kensington, S.W.7 (December 7). A professor of anatomy in the University of Lucknow—The Registrar (December 31). A principal of the Denbighshire Technical Institute—The Secretary and Director of Education, Education Offices, Ruthin (December 31). A lapidary (male) for the Department of Mines, Ottawa, Canada—The Secretary, Civil Service Commission, Ottawa, Canada (January 6). A professor of physiology in the University of the Witwatersrand, Johannesburg—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (January 31). A principal of the University College of Wales, Aberystwyth—General Secretary of the College (January 31). A lecturer in geography at the Bedford Training College—The Principal, The Crescent, Bedford. A lecturer in mathematics in the Gordon College, Khartoum—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S.W.1 (marked "Lecturer").

Our Astronomical Column.

COMET COMAS SOLA.—This comet is 1926 *f*, being the sixth to be detected during the year; but four of the six, also Neujmin's Comet, 1926 *g*, were periodic comets observed on their return to perihelion. Mr. G. Merton has photographed the new comet on two nights, and Mr B M. Peek sends the following notes on its physical appearance With a 12-inch mirror, power 200, the diameter of the nebulosity is 1′ using averted vision. Direct vision shows a coma of 15″ diameter, and a stellar nucleus of 12 mag, the total light being fully 11 mag.

Herr Ebell has deduced the following orbit, which is still uncertain owing to the distance of the comet and its slow motion:

T	1927, May 14·333 U.T.
	62° 48′
Ω	57 15
i	24 57
log *q*	0·24405

EPHEMERIS FOR 0^h U.T.

	R.A.	N. Decl.	log *r*.	log Δ.
Nov 21	40^m 25^s	7° 36′	0·4437	0·2614
29	32 25	8 19	0·4326	0·2548
Dec 7	25 6	9 11	0·4213	0·2518
15	19 8	10 13	0·4097	0·2528

The comet is well placed for observation, being on the meridian before midnight. It is likely to become an easy telescopic object during December.

MODERN ASTRONOMY.—The July issue of *Natural History*, the journal of the American Museum of Natural History (vol. 26, No. 4), is an attractive number devoted entirely to astronomy. Prof. S. A. Mitchell (Director of Leander M'Cormick Observatory) writes on total solar eclipses, of which he has seen six, involving journeys of 50,000 miles in all. The three latest American eclipses of 1918, 1923, 1925 are described in great detail. That of 1923 had the best weather prospects, but the least successful results. Beautiful coloured reproductions of these three eclipses, by Mr. Howard Russell Butler, are given. He describes his method of working in the second article. He notes that there are three factors of colour—brightness or value, prismatic hue, saturation. He makes rapid outline sketches, indicating in shorthand the values of these factors for each region, and works the picture up from these, using photographs to improve the outlines. He also reproduces a coloured picture of a lunar crater lit by a low sun. The sunlit portion is nearly white, with various faint tints. The part in shadow, lit by the sunlit walls and by the earth, varies from greenish brown to brown. The gibbous earth is shown, the ocean being blue, polar regions and solar reflection white, clouds and land light brown; the sky is dead black and star-studded.

Prof. G. E. Hale writes on solar tornadoes. He gives some beautiful spectroheliograms of prominences, filaments, and vortices, describing the paddle apparatus he has invented for imitating the latter. He mentions the curious change in polarity of sunspots at the beginning of new cycles, but points out that the change is not shared by the high-level hydrogen vortices, which seem to follow the same law of rotation as terrestrial storms. Incidentally, he refers to stars using their energy to build up the atom from electrons and protons. Inasmuch as other physicists are relying on the stars deriving their energy from the atom, to explain the immense duration of their life as suns, there would seem to be need of co-ordination, so that astronomers may not be liable to the accusation of forgetting the conservation of energy, and trying both to "eat their cake and have it."

W. J. Luyten writes on "island universes." He takes the recently adopted distances (ranging from a million light years) as fully established, and studies their size, etc., on this basis. He dates the "era of island universes" from Lord Rosse's discovery in 1845 of the great spiral nebula in Canes Venatici; but surely Sir William Herschel is entitled to the pioneer honours. Many of his estimates of the size and distance of these objects were of the same order as those adopted to-day.

Research Items.

ILLEGITIMACY AND RACIAL INVASIONS IN BRITAIN.—Dr. John Brownlee has published in *Man* for October an interesting note on the distribution of frequency in illegitimacy in the north of England and Scotland, and its relation to and bearing upon the evidence for racial migration. In the north of England there is a sufficiently close correspondence between the distribution of the round barrow and that of illegitimacy to suggest that this custom was introduced at the beginning of the Bronze Age, and that the invasion of Angles was not sufficient to do more than introduce a new racial element into this part of the country without modifying the custom Information on illegitimacy in Scotland has been studied in more detail. The range of variation is much greater, the highest percentage of illegitimacy occurring in Aberdeenshire and in the southern districts of Scotland, especially Dumfries and Galloway. The Aberdeenshire district contains a larger proportion of broad-headed persons than any other part of Scotland; but the broad-headed population of the Aberdeenshire tombs is more closely allied to the type of central Europe than is that of Yorkshire and southern England. The percentage of illegitimate to legitimate births is 12 to 15, a rate comparable with that of central Europe. In Dumfries and Galloway there is no broad-headed association, the population being the most narrow-headed in Scotland; but here a close association with a certain type of hill-fort appears. This type of fort belongs to some period about the beginning of the Christian era. In the Norse settlements, Orkney, Shetland, and the western islands, the illegitimacy rate is low, but there are pockets in the north, chiefly adjacent to the coast, where the rate is high.

FOSSIL APES AND MAN.—In the recent issue of the *Bulletin of the Geological Society of China* (Vol. 4, No. 2) Dr. Davidson Black reviews our present knowledge of the distribution of the primates, living and extinct, with special reference to the ancient geography of Asia and its bearing on the ancestry of man. He accepts the principles enunciated by Dr. W. D. Matthew in his well-known essay on "Climate and Evolution" published in 1915, and refers to them repeatedly in his discussion of the subject. He especially emphasises the fact that at any one time the most advanced members of a group of animals must be nearest the original centre of its dispersal, while its lowest or most conservative members are farthest from this centre. Dr. Black then shows on a series of maps the present distribution of the several groups of primates, with the few known records of their extinct representatives. Central Asia, north of the Himalayas, is thus suggested as the region in which they successively originated and from which they were dispersed. Finally, Dr. Black shows the distribution of the known fossils on six maps which represent the continental lands of the successive Tertiary periods, according to Dr. A. W. Grabau. A discussion of these maps leads to the same conclusion, and Dr. Black looks most hopefully to an exploration of the Tertiary sediments in the southern foothills of the Tian-Shan mountains for the discovery of remains of the immediate ancestors of man. Both geologists and anthropologists will await the result with great interest.

FERTILITY IN THE COMMON MULE.—Dr. E. Warren (*Ann. Natal Mus.*, vol. 5, pt. 3, 1926) records an interesting case of fertility in a mule about the authenticity of which there appears to be no doubt. The mule is the result of a cross between a jack donkey and a dark chestnut mare, and was in foal to a hackney stallion. It was eight years' old when it first foaled and is believed to be in foal again. It produced abundant milk and suckled its foal in a perfectly normal manner. Dr. Warren describes the sire, the mule dam, and the foal in some detail with special reference to the degree of likeness of the latter to each parent. He finds that the extent of the prepotency of the parents, and the dominance of the characters, with respect to features which are diagnostic of the two species, horse and ass, vary within wide limits and range from nearly complete dominance to perfect blending.

AUSTRALIAN BIRDS.—The second edition of the official check-list of the birds of Australia has now been issued by the Royal Australian Ornithologists' Union. It has been published only after considerable deliberations on questions of nomenclature by a representative committee of Australian ornithologists and adheres fully to the code of the International Commission. The list gives for each bird the accepted generic, subgeneric, specific, and vernacular name, the range in Australia and beyond, references to the original use of the accepted name and to the standard works of Gould, Mathews, and other workers on Australian birds. A very useful appendix gives the derivations, pronunciations, and origin of all the scientific names used. The work appears to have been very thoroughly and completely done, and, as it has been compiled after due consultation with Mr. G. M. Mathews, who has worked intensively in this field of late years, the list may be regarded as authoritative. As such, it will prove invaluable to ornithologists generally and to museums in particular.

PLANT GROWTH IN THE SEA.—The third number of the *Journal of the International Council for the Exploration of the Sea*, edited by Dr. E. S. Russell and published in Copenhagen in August, keeps up the high standard of interest and utility of the first two numbers. The present issue contains an article on chemical factors concerned in plant growth by W. R. G. Atkins, and original papers by P. Jespersen, Oscar Sund, and C. H. Roberts, whose observations on the rate of absorption of atmospheric oxygen through thin films of fuel oils show how rapidly this may occur, and indicate that oil pollution does not markedly slow down the oxygenation of sea water, although it may be directly harmful to marine animals, since all the oils tested were found to be toxic to fish. In the first article, Atkins correlates a large amount of information concerning chemical factors, most of which has been obtained during the past ten years, as may be seen from the bibliography of more than fifty references. The information has not been brought together previously, and compilations of this kind are much wanted. A point of general interest which has arisen from these researches is the great fertility of the sea; from changes in alkalinity and hydrogen ion concentration it is calculated that the suspended vegetable organisms in the open water of the English Channel every summer use sufficient carbon dioxide in photosynthesis to produce 3 grams of dextrose from every cubic metre of water, or 250 metric tons of dextrose over an area of 1 square kilometre. This corresponds to the annual production of 1400 metric tons wet weight of vegetable plankton organisms per square kilometre in this district, a value which is confirmed by the amount of phosphate utilised annually.

Starch Formation in the Presence of Different Salt Ratios.—The real complexity presented to the investigator by 'calciphobe' and 'calciphile' vegetation is probably well indicated by some recent experiments by Dr. V. S. Iljin upon starch synthesis in the presence of salts of calcium and sodium (*Bulletin de l'École supérieure d'Agronomie*, Brno, 1925.) Leaves of plants were immersed in weak solutions of maltose or glucose in the presence of varying concentrations of chlorides of sodium or calcium, and the concentration noted which brought starch formation to a standstill. Plants growing on soils of high calcium content still continued to form starch in the presence of high calcium concentration; on the other hand, even low concentrations of sodium salt prevented synthesis. Halophytes, on the other hand, continued to form starch in concentrations of sodium up to 0·35-0·5 *M*. Some species reacted in this respect at definite salt concentrations quite irrespective of the nature of the soil on which they were previously growing, whilst other species behaved quite differently when taken from soils rich or poor in calcium. Iljin concludes that we may not speak of 'phily' or 'phoby,' but only of the degree of tolerance of the plant to the injurious action of some salt. A plant particularly resistant to such injurious action may be placed at a considerable advantage in the struggle for existence in a soil in which the salt in question is present in a relatively high concentration.

Inheritance of Melanism in Lepidoptera.—Heslop-Harrison (*Journ. of Genetics*, 17, 1, 1926) continues the description and discussion of his remarkable experiments upon the inheritance of wing colour and pattern in the lepidopteran genus Tephrosia. He finds that, in interspecific crosses between *T. crepuscularia* × *T. bistortata*, melanism, introduced by the latter, remains, as it does within the limits of a species, a Mendelian recessive; that the progeny carrying two female characters (♀♀) out of a *bistortata* (female) × *crepuscularia* (male) mating are non-viable; that in back-crosses between *bistortata* (♀♀) and the two possible of the F_1 generation carrying two male characters (♂♂), one half of the ♀♀ dies; and that in the reciprocal *crepuscularia* (♀) × *bistortata* (♂♂) crosses, the sex-ratio among the offspring is undisturbed.

The Infection of Tree Roots by *Armillaria mellea*.—This root rot is one of the most serious of tree parasites and is usually assumed to enter through a wound. Considerable interest therefore attaches to the observation of S. M. Zeller (*Phytopathology*, 16, 479-484, July 1926), who gives grounds for thinking that if an infected root runs across a healthy root, even when both are of considerable age, infection gradually spreads to the healthy from the diseased root, layers of dead flakes being sloughed off the surface of the healthy root as new cork layers are formed in the bark parenchyma. With prune trees, evidence has also been obtained of the entry of the fungus through the little collar around the base of the emergence of a branch root, presumably as the result of the rupture of the bark parenchyma of the parent root during the emergence of the lateral.

The Possible Identity of different Mosaic Diseases.—An important paper upon this subject by M. N. Walker appears in *Phytopathology* (16, 431-458, July 1926). Cross inoculation with the mosaic diseases of cucumber, tomato, and physalis confirms other accounts as to the difference in behaviour of the virus in the expressed juices of these plants; thus tomato and physalis juice withstand ageing, drying, dilution, etc., whilst the virus of cucumber juices is much less resistant to such treatment as drying. On the other hand, the disease on tomato produced by injecting with cucumber mosaic shows the usual properties of tomato mosaic, and, conversely, the disease on cucumber obtained after inoculation from either physalis or tomato shows the usual great susceptibility of the extracted virus in cucumber juice. The conclusion would appear to be that the infective principle in each case was the same, and the differences in the properties of the extracted virus are to be attributed to the properties of the juice of the host plant.

A Tertiary Inter-basaltic Flora from Western America.—Dr. F. H. Knowlton has studied the fossil flora of the beds of clay and shale, named the Latah formation and found in Washington and Idaho (*U.S. Geol. Survey Prof. Paper* 140-*A*, 1926). These beds were formed by the obstruction of the drainage due to the advance of the great lava flows of the Columbian plateau, and are in places overlain by a later series of flows. The plants are unusually well preserved and are of interest as affording evidence bearing on the age of the lavas. Ninety-five forms are recognised, of which 51 are regarded as species new to science, 25 as species found in other areas, and 18 are not named specifically. As a whole, the flora is very modern in appearance, the oaks, elms, maples, and poplars being similar to certain living forms. Taxodium was one of the most abundant forms, and a Sequoia is also common, while Ginkgo is represented by a few specimens. Most of the new species are founded on remains of leaves, but a considerable number of remains of reproductive structures are present, some of which have not been specifically identified. The floras are regarded as showing affinities with those already described from beds of Miocene age. The diatoms of the deposit are described by Dr. A. Mann, who describes 11 new species and some interesting twin forms.

New Theories of the Mother-Rock of Californian Petroleum.—In any oilfield the point of chief theoretical interest is the original source of the oil and the character of the organic matter whence it was derived. Since 1907 the generally accepted theory ascribed the bulk of Californian oil to Miocene diatomaceous shales, and the example has been used repeatedly to illustrate an almost ideal mother-rock, and further an advancement of the hypothesis of marine organic origin of petroleum. With the development of the great oilfields of the Los Angeles Basin, however, there has latterly been some doubt raised as to the validity of the diatomaceous shale theory; in fact, in one case, that of Santa Fé Springs, it would seem to be established definitely that the oil originated in younger formations, namely, the clay-shales of the Fernando group (Pliocene), since the deepest well, drilled to 7215 feet, was not abandoned until it was 2500 feet below the top of the rich oil-bearing sands, the last 1000 feet being barren beds; at the bottom of the well some fossiliferous Fernando beds were proved, thus showing that the Miocene (Puente) shales had not been reached. It is reasonably argued that the great thickness of barren beds present in the lower part of the Fernando formation inhibits the theory of a Miocene mother-rock for the Santa Fé Springs oil, since, had this older horizon been competent in this respect, the Fernando sands would have been successively richer in depth. The fact that Santa Fé Springs has been one of the largest oil-producing fields in the world (for many months in 1923 it was giving a daily production of more than

42,000 tons of oil), is further significant. Recent papers of G. C. Gester, J. E. Eaton, G. E. Cunningham, and T. F. Stipp in *Bulletins of the American Association of Petroleum Geologists* have done much to create the doubt of alleged oil-source in this region, in fact throughout California; but with the appearance of W. A. English's *Bulletin* (*No. 768*) on the Puente Hills Region (which includes part of the Los Angeles Basin), recently to hand from the United States Geological Survey, the alternative theory receives official support, and it is clear that we must prepare to modify considerably our faith in diatom-shales as ideal mother-rocks. Foraminifera, not Diatomacea, are the prominent organisms of the Fernando beds, especially of the oil-measures.

COEFFICIENTS OF EXPANSION AT LOW TEMPERATURES.—An accurate knowledge of the coefficients of expansion of solids at low temperature is necessary for testing theories of the solid state, and R. M. Buffington and W. M. Latimer have obtained expansion data for aluminium, copper, silver, rock salt, quartz parallel to the optical axis, and pyrex glass between 90° and 315° K. The Fizeau interference method was used, and a full description of the investigation is published in the *Journal of the American Chemical Society* for September. The coefficients of expansion of the crystalline solids, which change slightly more rapidly than do the specific heats, approach zero at low temperatures, in agreement with the prediction of Nernst. It was possible, from the data on aluminium, copper, and silver, to introduce terms depending on the constraints between the atoms into the equation for the entropy of solids, and the entropies of six monatomic solid metals are shown to be satisfactorily represented by the new equation.

PHOTOGRAPHY AT LOW PRESSURES.—The May issue of the *Memoirs of the Kyoto College of Science* contains a paper by Osamu Masaki on the effects of low pressure on the sensitivity of the photographic plate. Two pieces cut from the same plate were enclosed in two compartments in a glass-fronted brass box. The pressure in one of the compartments could be reduced to that of 0·005 cm. of mercury. The box was placed behind a rotating Hurter and Driffield wheel, the openings in which exposed strips of the plates for times in the ratio 1, 2, 4, 8, 16, etc. to the light of a 50-watt incandescent electric lamp of milky glass placed a metre away. The density of the film after development for 3 minutes was measured by means of a photoelectric cell and electrometer. In almost all cases the plates were more sensitive under reduced pressure, the effect being greater for slow than for fast plates. The reduction of pressure also reduced the tendency to fog. The greater part of these effects appears to be due to the drying of the emulsion, but some part is played by the removal of occluded gases under the reduced pressure.

VELOCITIES OF DIFFUSION IN GELS.—The *Science Reports of the Tôhoku Imperial University* for July 1926 contain a paper by M. Watanabé on the relation between the diffusion velocity and the concentration of the diffusing substance. The equation $K = m\log C + n$, in which K is the value of $d/\sqrt{t}$ at the beginning of diffusion (d being the distance of the diffusion in time t), C the original concentration of the diffusing substance, and m and n constants, was found to hold at the beginning of diffusion of a salt from solution into a gel containing a reacting substance. O. von Fürth and F. Bubanovic consider that the equation holds if $K = \log d/\sqrt{t}$. For a limited range of concentrations it is clear that both formulæ apply, and Watanabé shows that this is due to the diffusion of the substances dissolved in the gel, which renders the results inaccurate. When a colloidal reactant was used the formula $d/\sqrt{t} = m\log C + n$, was found to apply over a wide range of concentration, while Fürth and Bubanovic's expression is limited to a few concentrations. In a further paper in this journal the formula is applied to the results of experiments on the diffusion of mixtures of copper and zinc sulphate solutions.

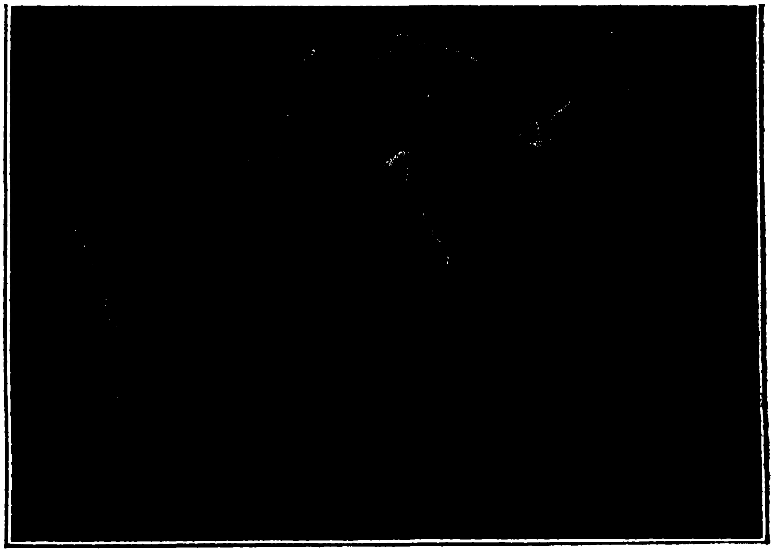
THE RATE OF REACTION OF NITRIC OXIDE AND OXYGEN.—H. B. Baker has shown that carefully purified and dried nitric oxide and oxygen do not react; but under ordinary conditions combination takes place rapidly, and W. A. Patrick and R. L. Hasche have studied the effect of increased glass surface on the reaction velocity. In the *Journal of the American Chemical Society* for September, Hasche describes further experiments in which the influence of a paraffin-coated reaction chamber, and moisture, sulphur dioxide, and nitrogen tetroxide have been measured. It was found that moisture increased the speed of combination, and the decrease in velocity caused by the paraffin surface is thought to be due to a decrease in the amount of moisture. In the absence of water vapour, a period of induction of about 10 sec. was noticed at initial partial pressures of less than 14 mm. The effect of sulphur dioxide and nitrogen tetroxide was negligible.

HEAT LOSS AND FRICTIONAL RESISTANCE IN AIR CURRENTS.—The relation between the heat lost by a hot surface when cooled by a current of air passing over it, and the frictional resistance experienced by the surface, has been subjected to investigation by many research workers. So early as 1874 Osborne Reynolds examined this question. That such a relation may exist appears clear from the fact that both the frictional resistance and the heat transference occur in association with the passage of momentum in the air in the neighbourhood of the surface. A further contribution to this subject has appeared in the Aeronautical Research Committee Report, R. and M. No. 1004 (H.M. Stationery Office, 1s. net). In this paper Miss D. Marshall has recorded two distinct series of tests. In the first place a short heated section of pipe, 5 in. in diameter, was cooled by a current of air forced through it, the heat transmitted being estimated from the rising temperature of the air. In the second test, thin rings of nickel heated electrically were supported in a wind channel, the transmitted heat being measured from the energy supplied to the ring. In this latter case the effect of artificially roughening the surface of one of the rings was specially investigated. In common with previous experiments, a considerable discrepancy is found to exist between the observed heat transmission and that calculated from the measured surface friction, a difference of 20 per cent. being found in the case of the smooth rings. In the case of the roughened rings, however, fairly close agreement is found over a considerable range of speed. Thus it will appear that the effect of surface roughness is much greater than would be anticipated, the dimensions and form of the irregularities constituting quite an important factor. The investigation must prove of considerable interest in its bearing on the surface friction of thin plates in the neighbourhood of the leading edge, for these results are in fairly good agreement with the law of surface friction deduced by Blasius from Prandtl's theory of the boundary layer. This agreement extends both to the law of variation of frictional resistance with speeds and the actual value of the forces.

Progressive Lightning.

DR. N. ERNEST DORSEY (*Jour. Franklin Inst.*, **201**, pp. 485-496, April 1926) in America, and Dr. G. C. Simpson (*Proc. Roy. Soc.*, A, vol. 111, No. 757, May 1926) in England, have recently published papers in which they have discussed from theoretical considerations the start and progress of a lightning flash, and in a recent number of NATURE (August 7, p. 190) these two authors discuss the question again, and even if they do not arrive at opposite conclusions they, nevertheless, are not by any means in accord.

So long ago as 1900 I made some apparatus with a view to obtain by experimental means, if possible, some evidence as to the progressive character of the lightning flash; but before dealing with this I think it well to refer the two authors to a paper by Dr. H. H. Hoffert (*Proc. Phys. Soc.*, **10**, 1890, pp. 176-179) which appears to me to bear on the subject, and which I think they have overlooked. Dr. Hoffert desired to test an assertion which I had made in a discussion on a paper by Mr. Whipple (NATURE, May 16, p. 71, 1889), to the effect that very often the lightning flash was multiple; two, three, or many more succeeding one another very rapidly along exactly the same path, which I thought was obvious to every one, but the truth of which, nevertheless, was not readily accepted. He therefore exposed a camera during a very heavy thunderstorm in the direction in which the frequent flashes were seen, and kept it waggling rapidly to and fro. So far as he knew, he exposed the plate to a single flash only. In the first place he obtained a triple photograph of the flash he had seen, the three images being widely separated. They are all identical in form, bea.ing out fully what I had said, but the photograph showed much more than this, and it is these other points that bear, so I think, on the later theoretical discussion. I have three prints which Dr. Hoffert gave me at the time, which are entirely untouched.



The print accompanying the paper is exceedingly faithful and true for the purpose of illustration, and there is a skeleton diagram with reference to which Dr. Hoffert gave a very full discussion of all that is shown. The point of greatest interest in connexion with the controversy above mentioned is the almost certain conclusion that a flash within the cloud and terminating (or starting ? C.V.B.) at a point from which the main flash started preceded this by a very evident interval. The other point of interest is that this region remained luminous all that time and until the third main flash had occurred; also that the more marked angles in the main flash, which may have been foreshortened portions directed towards the camera, also remained luminous in the intervals between the three main flashes. These were more in the upper part of the flash from which branches directed towards the ground emanated, and the branches were far more conspicuous in the first of the three main flashes. The lower part was devoid of branches and of continuous luminosity. Reproduced herewith is one of Dr. Hoffert's prints (Fig. 1), but I doubt if the more delicate features can be reproduced. It would be better added to Dr. Simpson's collection if it interests him.

Before describing my apparatus of 1890 I should like to refer to an observation which I made about the year 1876, as in a life's observation of lightning the phenomenon then accompanying every flash is one which I have seen on no other occasion. It may have some bearing on the conclusions of the two authors. A storm one evening in the autumn had passed directly over the village of Wing in Rutland and moved away to the north, leaving a clear starlit sky above the thundercloud, with the stars of the Great Bear in their lowest position far above. When the storm was distant about ten miles and more, for every flash seen in the rain cloud and below, and simultaneous with it, there were one or more very slender flashes of typical lightning form from the cloud upwards and many times as long as the usual kind of lightning below. According to my recollection, these reached one-third or perhaps half-way towards the stars of the Great Bear, and in one instance there were seven of these flashes going simultaneously into the clear sky.

Coming now to the year 1900, I wished to obtain some experimental evidence, if possible, of the progress of the lightning flash. The impression that there is a downward direction in a flash is very common, and occasionally observers believe one has an upward direction. Without paying too much attention to impressions of this kind, and yet not ignoring them altogether, I desired to make a conclusive test, and to get any information possible as to the beginning or to the progressive character of the flash. The scheme was to use a pair of identical camera lenses (specially selected for stereoscopic photography) and to mount these on a disc which could be rotated by hand through gearing at any desired speed. In the apparatus I then made I could drive them at any speed up to about forty turns a second. The lenses were four inches apart, centre to centre; the two images of a lightning flash would then be carried in opposite directions at any speed up to about forty feet per second, and if the flash in each part of its length should be 'instantaneous' a difference in time between the two ends of the flash of about $\frac{1}{10000}$ second would be observable. If, for example,

the flash were a vertical line and the lenses at the moment were one above the other, one image would be tilted in one direction while the other would be tilted in the other direction, and the more so the greater the duration. If the lightning were not at any part 'instantaneous,' by which I mean if it lasted long enough for its image to be broadened —that is, $\frac{1}{40000}$ second or more—the two images would fade away, but on opposite sides, and the sharp side would still be available for comparison. If the lenses should happen to be on the same level, then one image would be lengthened and the other shortened, and measurements between well-defined kinks would show this. Similarly for other positions of the lenses there should be both tilting in opposite directions and change of length. If the duration of the illumination at each point in the flash should be sufficiently short the stereoscopic method of observation seemed to promise to be most convenient. For this purpose it would be necessary to cut a print, taken from the 10×8 backed plate used to receive the images, into two parts, and to slide the two parts so as to bring the two images to stereoscopic distance, and so that the motion due to the lenses was parallel to the line joining the eyes. If then they were maintained strictly parallel to their former positions, the effect of the movement due to the lenses, if apparent, would be to make the stereoscopic image appear to leave the plane of the paper; and owing to the extreme delicacy of the stereoscopic sense, this might be as valuable a test as a micrometric one and much more convenient.

I made this apparatus in 1900, and carried it about with me, for example, to the British Association meeting at Glasgow the following year, and only once obtained a moderately good view of a few flashes, but the developed plates showed nothing at all! Though I have had this now for twenty-six years, I still have not succeeded in obtaining any photograph. It had been my intention to go on until I did get a result before describing the method, but as I now have no window in London with a good sky view, and in my present house at St. Marybourne in Hampshire, while I have all the sky there is, I have no 'compact' storms such as we so often have in London. For twelve years I have not seen a storm in which the lightning is fairly frequent and in one direction, which is what I mean by 'compact,' and therefore if any results of interest are ever to be obtained in this way they must be by some one else. If Dr. Simpson thinks the method worth following, the apparatus with the 10×8 double back, which it is made to take, is freely at his disposal.

In the case of a multiple flash on the same track the different pairs of images would be at altogether different azimuths, and the wheel of lenses might well have made more than one turn between each. They would therefore in no way clash when examined. There might, however, be a marked difference between the first and succeeding flashes if the first showed any sign of progressive character due to the operations discussed by Drs. Dorsey and Simpson. The first flash has certainly left the whole track conducting, and succeeding flashes therefore might well fail to show any such progression.

There is one more experiment which I have wished to make with this apparatus. This is to fire a rocket towards or into a thundercloud when it is getting ripe for another flash. The ordinary display rocket would do perhaps, especially if its head were removed and its stick lightened. I should, however, prefer to make suitable rockets on purpose with perhaps an extra calibre of composition over the spindle and no head. Such a rocket would go at an immense speed to twice the usual height if undisturbed by lightning on the way, leaving a conducting trail of potash smoke and ions of every kind. A six-oz. rocket ($\frac{7}{8}$ inch) or a half-pound (1 inch) would be the most convenient to use. The pound rocket ($1\frac{1}{4}$ inch) is more difficult to make, but it would be very persuasive, while a 3 lb. rocket ($1\frac{3}{4}$ inch), the largest within my experience, is too much of an undertaking and too dangerous in its descent to be lightly selected.

If a photograph were obtained with the revolving lenses of a flash striking a rocket a good way up, the rocket itself might be expected to be the place of origin of the flash, and this position would be obvious on the plate, as below this the lightning would no doubt follow the rocket trail.

Rocket-directed lightning also would be good for spectrum examination, as a prismatic camera could be employed with certainty as to time and direction. There might be some indication of potassium in the spectrum below the rocket, and a great splash of potassium at that place if the lightning got inside and fired the remaining charge all at once.

To fire such a rocket, the only safe plan would be to pull a string lying on the ground and leading to a striker at the rocket. No slow match would work at the desired instant, and electric communication by wire would be too dangerous. I am unable to make the rocket experiment as I am in a village of thatched houses.

C. V. BOYS.

The Detection of Icebergs.

THOUGH navigation in iceberg-infested waters has been recognised from early times to be fraught with special dangers, it is only comparatively recently that attempts have been made to apply scientific methods to the detection of these floating dangers to navigation. Early whalers and explorers in Arctic and Antarctic waters met and surmounted these dangers without such assistance, but the present circumstances of sea travel in waters occasionally subject to invasion by icebergs are so different as to render special precautions necessary. Some of these circumstances are the increasing size and speed of passenger vessels, the replacement of wooden hulls by steel, and the need, in the face of competition from rival steamship companies, to complete the voyages within scheduled times. The small ice 'growler,' floating almost submerged, is not only the most difficult to detect, but is also almost as dangerous an obstruction to modern steel ships as the iceberg of large dimensions, which is likely to be more readily perceived even in a fog.

The apprehension of the need for early warning of the approach of the ice has been especially lively since the *Titanic* disaster in 1912. This disaster led directly to the formation of the International Ice Patrol, which now maintains a continuous patrol during the ice season in the dangerous area of the North Atlantic. This organisation is maintained by the United States, the countries chiefly concerned contributing to the cost in proportion to their shipping tonnage. At present the chief duties of the Ice Patrol are: The continuous location of ice endangering the shipping lanes, and dissemination of relevant information to vessels approaching the danger area; oceanographical

work associated therewith; the investigation of various devices and aids to the location of casual icebergs, and of the waters of polar origin in which they are found.

The early experiments of Profs. Barnes and L. V. King on the detection of icebergs by temperature differences in the neighbouring sea water, which were carried out with the assistance of the Canadian Government, seem to have been unsuccessful, since we find that attention is now being concentrated on underwater echo methods of detection similar to those used for echo sounding. These methods formed the subject of a recent illuminating article in NATURE, May 9, 1925, p. 689. In the 1925 season an echo sounder of U.S. Navy type was tried by the Ice Patrol, and it was established that weak echoes could be obtained from a large iceberg in favourable circumstances at a maximum range of 2500 yards, the echoes being, however, first reflected from the bottom of the sea. 'Growlers' and very small bergs did not reflect well under normal conditions.

In the meantime, it is encouraging to note that the Canadian Government and the Research Council of Canada have afforded Prof. Boyle and his co-workers the financial and material assistance which has enabled them to institute a series of fundamental investigations[1] on the properties of ultrasonic (high-frequency) sound waves in water. Some tests have also been carried out at sea. The investigations included the measurement of the energy in an ultrasonic sound beam in water by means of a torsion pendulum, together with the measurement of the energy reflected from various materials, such as steel, various types of rock, and ice immersed in the water. The lateral distribution of energy in the sound beam has also been determined in this way. One of the most striking experiments has been the production of stationary waves in a small tank, which were made evident by the pattern formed on a tray by the dust of coal cinders which had fallen slowly through the acoustic energy field above. This method of rendering visible the interference pattern due to the combination of direct and reflected beams has been utilised to check the values of the coefficient of reflection from different substances by decreasing the energy output of the transmitter until a definite pattern just failed to form in the case of each reflector.

The experiments showed that ice was, of the materials tried, the worst reflector of sound. This, indeed, was expected from the fact that the products (density × velocity of sound) for ice and water differ little from one another. The circumstance that ice in its natural condition contains a considerable amount of included air in the form of bubbles held under pressure will, however, tend to make the detection of icebergs by echo methods less unpromising than might be judged from calculations on the basis of the data relating to pure ice, while the variations in temperature and salinity in the water surrounding a melting berg must also be taken into consideration.

The final report details the results of some practical trials to determine the range of iceberg detection at sea by the use of a high-frequency sound transmitter fitted on the s.s. *Montcalm*, a vessel maintained by the Department of Marine and Fisheries of Canada. It was anticipated that the small transmitters used would enable echoes to be obtained from rocks at a range of about 1000 yards, and this estimate was found to be justified. Echoes from a medium-sized iceberg were detected at a range of only 250 yards, but echoes due to multiple reflections between the berg and the ship were observed in other cases at a distance of 150 yards. In spite of this statement, it is clear that a very accurate measurement of time interval between echoes must be made before the explanation of the cause of the multiple echoes can be accepted. It is stated that the tests, which were carried out in shallow water, showed that echoes from the bottom and surface of the sea were a source of disturbance up to and beyond the time of arrival of the echoes from the iceberg.

The results obtained by Prof. Boyle are promising in that more powerful transmitting apparatus has already been constructed by him. Whether a reasonable increase in power will permit detection of the smaller icebergs and 'growlers,' which must be considered the most dangerous types of ice, can only be decided by further practical experiments at sea. In view of the attitude already displayed by the Canadian Government and by the Research Council of Canada, there is room for little doubt that Prof. Boyle will be enabled to continue his investigations to a point which will decide whether the directional high-frequency, or the relatively non-directional low-frequency, sound beam is better adapted for the detection of floating ice. C. S. W.

[1] *Trans. Roy. Soc. Can.*, Third Series. Vol. 19, 1925, p. 167. "Visualisation and Energy Survey of a High-Frequency Diffraction Beam." By R. W. Boyle, J. F. Lehmann, and C. D. Reid. Vol. 20, 1926, p. 245. "Reflecting Powers of Various Materials for Ultrasonic Waves." By R. W. Boyle and G. B. Taylor. Vol. 20, 1926, p. 233. "Practical Experiments on the Detection of Icebergs and on Sounding by Means of an Ultrasonic Beam." By R. W. Boyle and C. D. Reid.

The Total Solar Eclipse of January 14, 1926.

A JOINT meeting of the Royal Society and Royal Astronomical Society was held at Burlington House, London, on Thursday, November 11, to discuss the results obtained by the British eclipse expedition to Sumatra in January of this year. The Astronomer Royal opened the discussion with an account of the coronal pictures obtained by various eclipse expeditions in the past sent out from the Royal Observatory, Greenwich. In addition to the well-known changes of form with the solar cycle, he pointed out the close connexion of certain prominences with arches in the corona, and also certain changes detected as taking place during an eclipse, as seen from a comparison of plates taken at widely distant stations.

Mr. C. R. Davidson gave an account of the instrumental arrangements made for the Sumatra observations (see NATURE, February 27, p. 306), and of the chief results obtained from it. A study of the objective-prism spectra obtained by Col. J. Waley Cohen with a camera of 38-foot focal length, and by Dr. F. W. Aston with a 19-foot camera, gives the heights to which the different elements can be traced, the observed heights being in general accordance with previous results. The coronal rings show evidence of intensification in the neighbourhood of several prominences; the brightening does not quite coincide either in position or in form with the prominences, but some close relation seems to be indicated. The plates taken with the Grove-Hills flint slit-spectroscope do not go beyond the oxygen triplet at λ 7772. The dicyanin stain failed to work satisfactorily under the conditions of heat and damp prevalent in Benkulen. The wave-lengths of the two coronal lines in the green and the red were determined as 5303.4, 6374.1 I.A.U. The flash spectrum obtained by Mr. Davidson with the Grove-Hills quartz slit-spectroscope extends down to λ 3066. The lines have been measured and

grouped in series, where the data are available. In the coronal spectrum obtained with the same instrument, the lines from a high prominence, which also appear on the plate, gave an excellent scale for the coronal wave-lengths. These have been determined as 3387·95, 3454·11, 3601·03, 3642·87, 3800·77, 3986·82, and 4086·30 I.Å.U. The relative brightness of the lines of the corona differs from the values found in previous eclipses, but it is easily apparent that the lines themselves differ in the distribution of intensity with height above the sun's limb.

Mr. Stratton gave an account of the photometric work which has been done, by the kind permission of Prof. L. S. Ornstein, by Dr. Minnaert and himself on the ultra-violet slit-spectra with the aid of the Moll spectro-micro-photometer at the physical laboratory at Utrecht. The trustworthiness of the actual measures of intensity of the lines have been tested by examining certain multiplets which have been found to have relative intensities in close accordance with their proper values. The intensity of the K line has been measured at eight different heights and a satisfactory accord found over a range 30,000 km. to 100,000 km of height with the theoretical value calculated by Mr. P. A Taylor from Prof. E. A. Milne's theory of the chromosphere. The coronal lines also have been measured for intensity at different heights, and curves plotted connecting the intensity with the height. The lines were divided into three well-marked groups; the extreme groups confirmed the results found some years ago by Sir Norman Lockyer through a study of variations in the coronal rings from different sources. Attempts have been made from a study of line intensities to determine the temperature of the sun at different levels. In the Balmer series an application of Schrödinger's formula has given a temperature which decreases as the height above the sun's limb decreases. The temperatures deduced cannot be accepted, but what the observations gave was a measure of the weakening at lower levels in the chromosphere of the lines in the Balmer series corresponding to the atoms with the larger orbits. This weakening was to be expected from the increased ultra-violet radiation from the sun streaming through these lower layers; its extent has now been measured. Balmer lines from Hδ (6) to H 29 have been used in this work. The hydrogen continuous spectrum which extends towards the violet from the head of the Balmer series has also been examined. From this a measure of the temperature (the distribution of the velocities of the electrons) was possible. The value thus found, 1700° K. at 8000 km. height, is too low, as checked by a cross-determination from the relative intensities of certain ionised titanium lines at that same level and in the low level of the flash spectrum. One further result of interest in the photometric work is a study of the continuous spectrum in the low corona or high prominence at a height of 20,000 km. In agreement with the result obtained by Deslandres in 1893, this continuous spectrum when compared with that of a black body gave a lower temperature than the sun's temperature. The result is consistent with Ludendorff's recent work on the distribution of intensity in the continuous spectrum of the corona, which he finds to be unaltered from that of the sun. But Ludendorff's results come from much higher layers and are consistent with the light being scattered by electrons. The suggestion is that at the lower layers concerned the light is, partly at least, affected by Rayleigh scattering from atoms.

Prof. Ornstein raised the point whether a formula due to Miss Bleekers which fits many laboratory spectra need be rejected because when applied to the Balmer series it gives a negative temperature. This is very little different in reality from the extremely low temperatures given by the Schrödinger formula. Both formulæ make it clear that some disturbing factor is affecting the relative intensities of the lines, which clearly do not correspond to thermodynamical equilibrium. He welcomed the co-operation in this work of physicist and astrophysicist.

Dr. Minnaert dealt with the problem of comparing intensities at different wave-lengths and urged the necessity of extending our knowledge of a trustworthy curve of the intensity of the solar radiation for different wave-lengths. Abbot has not used sufficient resolving power to meet present requirements of spectrophotometers, and H. H. Plaskett's work needs to be extended more towards the ultra-violet. It is desirable that astrophysicists living in suitable climates should make further measures by photographic methods, if full value is to be obtained from future eclipse records.

The president of the Royal Society, Sir Ernest Rutherford, expressed his appreciation of Mr. Davidson's beautiful photograph of the Balmer series and of the kind co-operation of the Dutch scientific workers in reaping the fruit of the eclipse expedition, their own expedition having failed through bad weather conditions. It is the first time that intensity measures have been made on eclipse spectra; and the possibility of this has been due to the work of Prof. Ornstein and his colleagues at Utrecht.

Prof. Newall expressed great pleasure at hearing from the Astronomer Royal that Mr. Wesley's drawings of the corona are to be reproduced, and added his view that Mr. Davidson's ultra-violet spectra are the best yet achieved in eclipse work. He, too, welcomed the co-operation with the Dutch physicists and astrophysicists.

Prof. Fowler expressed admiration for the photographs, and pointed out with what refinement the adjustments must have been made. The photographs seen that day were remarkable for the large size of the solar image, and they should add considerably to our knowledge. He was interested to hear about the suggested relation between the coronal intensity and the prominences, as there is no evidence for it in earlier eclipses. The increased accuracy of the wave-lengths of the coronal lines should help in the further investigation of their source What is now required is higher resolution and more powerful instruments. Longer exposure is necessary, and this could be obtained by working on the edge of the belt of totality or even outside it.

Prof. Milne pointed out that the theories being tested at this eclipse are all of very recent growth. Prof Ornstein must feel gratified that his contribution is bearing fruit so soon. It is possible that some of the theories of solar physics will need to be revised. He was much interested in Mr. Taylor's results. It is clear that radiation pressure must play its full part in supporting the atoms at high levels if the chromosphere reaches the heights indicated. The low temperatures found at the lower levels of the sun only indicate that the fraction of the more highly excited atoms there is less than it would have been if the atmosphere had been in thermodynamical equilibrium. If the distribution of intensity in the continuous spectrum is due to atomic scattering, then it looks as though the prominence must consist of a mass of material thrown out with a comparatively high density.

Mr. R. H Fowler suggested that it is the laws of a perfect gas that are failing at lower levels rather than those of thermodynamical equilibrium. He had made a rough numerical estimate of the falling off of

intensity of lines of the higher quantum numbers and compared it with Urey's correcting factor. That will account partly for the result expressed in terms of the parameter, T, as indicating a lower temperature.

Prof. Lindemann supported the view that the future of eclipse work lies with photometry rather than with the determination of wave-lengths. In discussing the continuous light, the possibility of light-scattering in the instrument should be borne in mind. He would like to see a negative temperature gradient in the sun, such as might fit the demands of convective equilibrium.

Dopes and Detonation.

WE have received a copy of the Air Ministry Reports and Memoranda, No. 1013, by H. L. Callendar, R. O. King, and C. J. Sims, published by H.M. Stationery Office. The primary object of the investigation which is described was the determination of the physical actions that delay or prevent detonation in the cylinder of an internal combustion engine.

The addition to petrol of non-detonating fuels, such as benzene, has long been familiar as a means of checking the onset of 'pinking' in a high-compression engine. In the case of benzene a large addition is required; alcohol and toluene are more effective than benzene by about 50 per cent., though they still appear to act mainly by dilution of the original fuel.

There are, however, other classes of substances, many times more effective than toluene, the action of which cannot be explained by dilution. Thus, in the case of lead ethide, the addition of 0·25 per cent. by volume is nearly as effective as 100 per cent. of toluene. Nickel carbonyl shows a similar order of effectiveness.

The action of such 'dopes' must evidently depend on some specific property requiring further investigation. It has been shown that the heavier paraffins, on account of their high critical temperatures combined with low critical pressures, are exceptionally liable to persist in the form of nuclear drops, which serve as foci of simultaneous ignition by compression owing to their low ignition temperature. The marked effect of pressure in promoting detonation is explained by the rapid increase of nuclear condensation with increased density of charge. The action of a dope in delaying detonation is to 'infect' the nuclear drops in such a way as to delay their ignition. The fact that these drops form a small percentage of the whole mixture helps to explain the possibility of a relatively small quantity of the dope being effective. It has been shown that lead ethyl and nickel carbonyl, two of the most effective metallic dopes, when mixed with petrol residues, decompose rapidly at temperatures above 200° C., depositing a film of metal on the surface of the liquid. This metallic film would tend to protect the nuclear drops from oxidation, and would help to keep down their temperature by reflecting radiation.

Organic dopes, such as methylaniline and xylidine, have the advantage that much higher compression ratios can be employed than in the case of metallic dopes without risk of fouling the engine with deleterious deposits. On the other hand, much larger quantities are required than in the case of lead ethide. Organic dopes probably act mainly by the dilution of the nuclear drops, which results in a rise in the ignition temperature; but the chemical reactions which may occur are very complicated and require further investigation.

University and Educational Intelligence.

CAMBRIDGE.—Honorary degrees are to be offered to the Maharajadhiraja Bahadur of Burdwan, the Right Hon. W. L. Mackenzie King (Prime Minister of the Dominion of Canada), the Right Hon. J. G. Coates (Prime Minister of the Dominion of New Zealand), and to Mr. W. T. Cosgrave (President of the Executive Council of the Irish Free State).

Amongst those elected to the Council of the Senate are Sir H. K. Anderson, Dr. T. C. Fitzpatrick, Prof. A. C. Seward, Mr. T. Knox Shaw, and Mr. F. J. M. Stratton. Mr. R. E. Priestley, Clare College, assistant registrary, has been elected secretary of the general board of the faculties, a body that is to be elected for the first time on November 30.

Mr. W. H. Florey, lately John Lucas Walker Student and Rockefeller Research Fellow, has been elected to a fellowship at Gonville and Caius College.

MANCHESTER.—The Council has made the following appointments: Dr. William Susman, to be lecturer in morbid anatomy and histology; Mr. C. J. Polson, to be assistant lecturer in chemical pathology; Mr. A. M. Downie, to be assistant lecturer in bacteriology; Dr. F. A. Mason, to be lecturer in tinctorial chemistry and dyestuffs; Mr. Arthur Riley, to be assistant lecturer in textile engineering; Mr. F. W. Bailey, lecturer in papermaking.

Dr. Ivar Waller has been awarded an honorary research fellowship in physics.

Dr. James A. Bowie has been appointed Director of the Department of Industrial Administration in the Manchester College of Technology. After the War, Dr. Bowie was appointed lecturer at the College, where he devoted his attention to industrial relations with special reference to problems of wages, profit-sharing, and copartnership.

THE Universities of South Africa form the subject of an article by Prof. H. Clement Notcutt, of the University of Stellenbosch, in the October number of the *University Bulletin* (issued by the Association of University Teachers). It is pointed out that whereas the Act of Parliament which brought the Union into existence provided that the English and Dutch languages should both be "official," Afrikaans, which differs from the Dutch of Holland both in vocabulary and in syntax and is the home language of a large part of the inhabitants of Dutch descent, has recently been given by Parliament the same status. Consequently there are now three official languages. In the schools, English and Afrikaans are taught with the intention that all children of European descent growing up in the country shall have an adequate knowledge of both languages, but there is an ever-present danger of their failing to acquire the power of using either with that exactness which is necessary for clear thinking. Prof. Notcutt might have added that the prestige won for Afrikaans has reacted unfavourably on the position of Dutch, and a movement inspired largely by enthusiasm for maintaining the Netherlands connexion and cherishing the traditions handed down from the original Dutch settlers is in fact tending to estrangement, for the Dutchmen of Holland cannot, generally speaking, find time to learn Afrikaans, nor can the Afrikanders spare for Dutch so much time as they could before Afrikaans became a literary and official language. It is estimated that a higher proportion of the *white* population is attending college or university than in Great Britain or any of the other British Dominions. A noteworthy characteristic of South African university students is their devotion to sports, in which respect they resemble the students of Oxford and Cambridge rather than those of the other English universities.

Contemporary Birthdays.

November 20, 1851. Prof. John Merle Coulter.
November 21, 1866. Sir John Carruthers Beattie.
November 22, 1868. Sir Thomas H. Holland, K.C.S.I., K.C.I.E., F.R.S.
November 22, 1875. Prof. L. N. G. Filon, F.R.S.
November 23, 1864. Dr. P. Chalmers Mitchell, F.R.S.
November 26, 1851. Prof. J. Cossar Ewart, F.R.S.

Prof. COULTER, botanist, was born at Ningpo, China, and he was educated at Hanover College, U.S.A. Early in his career, when only twenty-one years of age, he was botanist with the United States Geological Survey in expedition work in the Rocky Mountains. Afterwards he returned to his old college, becoming professor of natural sciences; next he accepted the chair of biology in Wabash College. President, and professor of botany in Indiana University from 1891 until 1893, he has been, since 1896, professor and head of the department of botany in the University of Chicago. He is a member of the National Academy of Sciences, Washington and of the National Research Council; and a foreign member of the Linnean Society of London.

Sir J. C. BEATTIE, a graduate of the University of Edinburgh, studied also at Berlin and elsewhere abroad. Professor of physics in the South African College, Cape Town, from 1897 until 1918, he is now vice-chancellor and principal of the University of Cape Town. In 1909 (collaborating with Prof. J. T. Morrison) he brought to successful issue a magnetic survey of South Africa.

Sir THOMAS HOLLAND, Rector of the Imperial College of Science and Technology, received his scientific training at the Royal College of Science, South Kensington. He joined the Geological Survey of India in 1890, and was appointed professor of geology and mineralogy in the Presidency College, Calcutta, in 1893. From 1903 until 1909 he was director of the Geological Survey of India. Returning to England he became professor of geology and mineralogy in the University of Manchester, occupying the post for nine years. The Geological Society of London awarded him its Bigsby medal in 1913 in recognition of eminent services rendered to geology, more especially during his tenure of office in India. Sir Thomas is chairman of council of the Royal Society of Arts.

Prof. FILON has been Goldsmid professor of applied mathematics and mechanics in the University of London since 1912. Born at St. Cloud, France, he was educated at University College, London, and his energies, in the past and present, have centred there.

Dr. CHALMERS MITCHELL was born at Dunfermline. He graduated at the University of Aberdeen and Christ Church, Oxford, studying as well at Berlin and Leipzig. Since 1903 he has been secretary of the Zoological Society of London. Dr. Mitchell has made notable contributions to biological science, and has in addition promoted wide interest in scientific progress generally by numerous articles and other works.

Prof. J. COSSAR EWART was born at Penicuik, Midlothian, and graduated at the University of Edinburgh. Sometime occupant of the chair of natural history in the University of Aberdeen, he returned to Edinburgh in 1882, becoming Regius professor of natural history. Prof. Ewart has specially studied fishery questions; whilst he has written many critical memoirs on the development of the horse and on animal heredity.

Societies and Academies.

LONDON.

The Physical Society, October 22.—**Ernest Wilson**: The corrosion products and mechanical properties of certain light aluminium alloys, as affected by atmospheric exposure. Experiments have been made upon the electrical conductivities, the corrosion products and tensile properties of high purity aluminium, and certain light aluminium alloys, which have been exposed to London atmosphere for a period of twenty-four years. The elements concerned are copper, nickel, manganese, and zinc in varying amounts up to a few per cent. There is also a note on the corrosion products of high conductivity copper.—**M. C. Johnson**: The distribution of intensity in a positive ray spectral line (Part 2). The distribution of velocity among the particles contributing to the 'moving' spectrum is compared with the distribution of velocity in positive rays measured by the electromagnetic method and with some investigations of Betschinsky and Döpel. The appearance of the many-lined spectrum of hydrogen in the positive rays, and the ratio of intensity of the 'moving' and 'resting' spectra is also considered. The inverse square law of probability of electron capture, and some consequences of the work of Wien and Rüchardt, are the most likely controlling factors in the several phenomena.

Optical Society, October 28.—**R. Kingslake**: The analysis of an interferogram. It has been frequently suggested that it should be possible to analyse mathematically the interferometer pattern produced by a lens, in order to obtain a measure of the aberrations from the coefficients of the terms in the various orders of x and y. x and y are here the co-ordinates of a point on the interferogram, the optical path difference of which relative to the central ray of the lens is known at once by counting the fringes. Results obtained by this method do not agree well with those obtained under identical conditions by the oblique Hartmann test. **T. Smith**: The stationary value of axially symmetric functions (Part 2). Alternative methods to those described in Part 1 of constructing a series representing the stationary value of a given function are developed and applied to evaluate all the terms not involving powers and products of the coefficients of the function higher than the eleventh. The formula in its optical applications enables the first 451 monorythmic aberrations of a symmetrical optical instrument to be determined.

Mineralogical Society, November 2.—**L. J. Spencer**: (1) Schultenite, a new mineral from South-West Africa. The colourless platy crystals from Tsumeb are monoclinic ($a:b:c = 0{\cdot}8643:1:0{\cdot}7181$, $\beta = 84^\circ\ 36'$ and gave on analysis by E. D. Mountain the formula $PbHAsO_4$. They are identical with crystals prepared artificially by the late Baron A. de Schulten in 1904 (see NATURE, Sept. 18, 1926, p. 411). (2) Aramayoite, a new mineral from Bolivia. This was found in 1925 in a silver-tin vein in the Animas mine at Chocaya. It shows a confused aggregate of cleavage plates with iron-black colour and brilliant metallic lustre. In addition to the perfect basal cleavage there are also good cleavages following a steep tetragonal pyramid. The mineral is pseudotetragonal. Analyses by T. B. McGhie and by E. D. Mountain give the formula $Ag(Sb, Bi)S_2$.—**K. Yardley**: (1) X-ray examination of aramayoite. Some photographs taken with the beam perpendicular to the perfect basal cleavage (001) show no symmetry; powder photographs also show that the tetragonal symmetry

apparently indicated by the cleavages does not actually exist. Ionisation spectrometer data reveal the triclinic nature of the mineral and give a complete crystallographic description: $a=5.672$ Å.U., $b=5.688$, $c=5.623$; $\alpha=86°\ 55'$, $\beta=90°\ 53'$, $\gamma=93°\ 18'$. The structure is pseudo-tetragonal with two molecules of Ag(Sb, Bi)S_2 in a minimum cell. (2) The structure of baddeleyite and of prepared ZrO_2. The natural form of ZrO_2 is monoclinic with four molecules in the unit cell. Ionisation spectrometer measurements on a single crystal and powder photographs both indicate a distorted CaF_2 arrangement of the ions. The structures of three specimens of the mineral from entirely different sources are practically identical, except for slight variations of spacing due to the presence of impurity. Powder photographs of prepared zirconia from two distinct sources are almost identical with those of baddeleyite and show that prepared zirconia is also monoclinic and not (as previously stated) tetragonal.—W. **Binks**: The crystalline structure of zircon. X-ray examination of zircon shows the structure of zircon to correspond to the space group D_{4h}^{19}. The unit cell containing eight molecules $ZrSiO_4$ has dimensions $a=9.30$, $c=5.93$ Å.U. The silicon and zirconium atoms form two interpenetrating face-centred lattices, and the oxygen atoms are arranged tetrahedrally around the silicon atoms. The structure has some resemblances to that of anhydrite ($CaSO_4$).

Society of Public Analysts, November 3.—W. R. **Schoeller** and C. **Jahn**: Investigations into the analytical chemistry of tantalum, niobium, and their mineral associates (vi.) The precipitation of the earth acids by sodium compounds. When tantalic oxide is fused with potassium carbonate and the solution of the mass treated with sodium chloride, 4 : 3 sodium tantalate is precipitated. Niobic oxide treated in the same manner yields 7 : 6 sodium niobate. The precipitates are dense, crystalline powders. Sodium tantalate and niobate are decomposed by dilute acid. The quantity of the latter is proportional to that of the alkali in the precipitates. This reaction was applied to the indirect volumetric determination of the earth acids in the mixed sodium salts, but the end-point could not be ascertained with sufficient sharpness with colour indicators.—A. E. **Parkes**: A simple method of testing for sulphites in foods. The food (if not a liquid) is mixed with water and placed with fragments of marble and dilute (about $2N$) hydrochloric acid in a conical flask, closed with a rubber stopper bearing a small thistle funnel bent twice and having a small bulb on each limb. The funnel contains a few drops of dilute ($0.01N$) iodine solution and dilute barium chloride solution. After evolution of carbon dioxide has ceased, the flask is heated, and, in the presence of a sulphite, the colour of the iodine in the funnel is discharged and the liquid becomes opalescent (barium sulphate). The test may be made approximately quantitative.—J. W. **Haigh Johnson**: A critical review of the methods of analysing waters, sewages and effluents, with suggestions for their improvement. Present methods yield results which are often inconsistent. Recent modifications in sewage treatment have greatly increased the amount of nitrogen oxidation products. Comparing the Wanklyn, Kjeldahl, acid chemical, and biological processes, the first is too vague, whilst the acid chemical test yields only a fifth of the result obtained biologically. A method of combining the Wanklyn test and the alkaline oxidation method is described, and suggestions are made for improving the Kjeldahl test and for the biological determination of absorbed oxygen.

PARIS.

Academy of Sciences, October 18.—G. **Bigourdan**: The equations of diverse origins, which may affect the pendulum corrections C_p adopted at the Bureau International de l'Heure (B.I.H.), year 1925.—Marin **Molliard**: The dimorphism determined in the gall of *Mikiola Fagi* by a secondary parasite. Some oak galls from the forest of Fontainebleau were observed to differ in shape and other characteristics from the normal gall, and this has been shown to be due to another parasite, identified by Ch. Ferrière as *Secodes coactus*. Similar galls have since been observed in abundance in other parts of France, Normandy, Brittany, Savoy.—Charles **Richet** and **Oxner**: The accommodation of salt-water fish to supersaturated waters. A study of the effect on *Sargus Rondeleti* of a gradual increase in the proportion of sodium chloride in the water. This fish could support a salinity 37 per cent. above the normal, but a diminution to 18 per cent. below the normal caused death. J. **Costantin**: The variability of living beings according to prehistoric man.—Ch. **Depéret**: The neolithic layer of Glozel (Allier). Some doubt has been thrown on the authenticity of the objects found at Glozel: the author's own excavations and observations confirm the view of Morlet that the find is authentic, and of extreme importance.—Léon **Guillet** and Albert **Portevin**: The influence of the chemical composition of alloys on the possibility of making castings.—E. **Bataillon** and Tchou **Su**: Activation and rectification in the parthogenesis of the echinides by hypertonic solutions alone.—Paul **Alexandroff**: The dimension of closed *ensembles*.—Léon **Pomey**: Partial differential equations and linear integro-differential equations with an infinity of variables.—Leonida **Tonelli**: The double series of Fourier.—G. **Cerf**: The characteristics of partial differential equations of the first order.—André **Roussel**: Certain isoperimetric problems.—H. **Galbrun**: The propagation of a sound wave in the atmosphere.—A. **Toussaint** and E. **Carafoli**: The theory of supporting wings.—A. **Dauvillier**: The discovery of the characteristic O and N series of low frequency. Spectrographic joining of the X-rays and the extreme ultra-violet. Utilising a thorium filament prepared by M. de Boer, good spectra have been obtained with 25 milliamperes at 2800 volts. These show the pure low frequency spectrum of thorium, consisting of the characteristic N and O radiations. The line 121 Å.U. approaches the optical spectra obtained by Millikan in the extreme ultra-violet (limit of aluminium, 136 Å.U.).—H. **Pilon** and A. **Laborde**. The immersion of metals in homogeneous media opaque to the X-rays. Improvement of radiographic methods. The method suggested consists in immersing the metallic body in a homogeneous saline solution the absorption co-efficient of which, for the X-rays used, is nearly that of the metal. Some suitable solutions are given: for aluminium a 35 per cent. solution of barium chloride, for iron, barium iodide (159 gm. in 100 c.c. of solution), for copper, the same barium iodide solution. Under these conditions discontinuity in the metal is very clearly shown.—Jean **Bouldoires**: The transformations undergone by aluminium bronzes. Results are given of a thermal analysis, measurements of resistance and micrographic study of aluminium bronzes submitted to varying heat treatment.—Georges **Delbart**: The magnetic permeability of cold-drawn steels.—Emile **André** and Mlle. Th. **François**: The saturated fatty alcohols of the oil of the sperm whale and of *blanc de baleine*.—Guy **Emschwiller**: The action of magnesium on methylene iodide. The reaction (in ether) is vigorous and takes place

a brilliant analysis of the phenomena of line spectra. Many of those who read papers before the sections of the British Association may feel aggrieved that the substance of their contributions is neglected, while considerable importance is attached to their incidental analogies. Then again, there is the large class of contributors whose papers are ignored altogether in the newspapers, and this is frequently attributed to the reporter's preference for the contributions of scientific workers of well-established reputation, or for those of distinguished laymen.

It is obvious there must be selection. A modest estimate of the average daily output during the Oxford meeting would be sixty papers. To do bare justice to them all, the newspapers would need to devote at least thirty columns daily to science news, and this would involve the employment of a staff of scientific experts for each newspaper, unless all editors were prepared to present to their readers exactly the same copy. But if the public demand for science news were sufficiently great to warrant such wholesale circulation, it is clear that it would also be sufficient to justify the publication of a science daily newspaper.

In existing circumstances, editors will select those items of news which they think will appeal to their particular public. But any author of a paper can help them materially in this process of selection if he will take the trouble to prepare for the official programme of the Association, a summary which is not only written in language intelligible to the average well-educated member of the community, but also calculated to awaken interest either from the newness of its facts or the novelty of their presentation. It is useful if, in addition, one or two copies of his complete paper are available in advance to the reporters in the Press Bureau, as this widens the scope of selection of individual reporters. Attention to such matters as these will usually safeguard an author against misrepresentation of his facts, theories, and opinions. The title given to a paper is also important in this connexion. "The Hygroscopic Relations of Colloidal Fibres" conveys all that is necessary to members of Section A, but is not likely to interest a reporter with limited space and time at his command, who sees, moreover, that there are a dozen other papers with far more attractive titles to be delivered the same day. He is only human in preferring to look to papers on "Intelligence in Rats," the "Psychology of Patriotism," or "The Public Schools and National Life" for his copy.

It is not suggested that scientific workers should aim at providing reporters with 'stunts,' or that the importance of scientific investigations be judged by their immediate value as copy for newspapers or topics of conversation. But it is clearly worth while to present the results of investigation in any one branch of science and theories based upon them, in a form which will enable every scientific worker, as well as the specialist, to appreciate them. Since the general public is also interested in science, there seems every reason why it should be provided with the best of science, and every assistance given to reporters—the channels of communication between science and the public—in the difficult task of selection and presentation. Serious scientific workers are themselves partly to blame for having the patient work of years dismissed in three or four unintelligible lines. They have put a new weapon in the hands of humanity; they have insensibly imposed upon it a new mental outlook; upon them devolves the responsibility of enabling all members of the community to understand the functions, aims, and methods of science, and the essence of the scientific spirit, its fearlessness in facing facts, its determination to resist prejudice, and its constant researches to test the validity of theories or the universality of laws.

If scientific workers will not seriously apply themselves to the task of securing greater and better publicity for their work, other than that which they obtain in the scientific and technical press, and reports of proceedings of learned societies and institutions, they must not complain of the manner of the publicity. They must be prepared for valuable utterances and suggestive discussions to be neglected in favour of th trivial and fantastic contributions made to the proceed ings by our scientific entertainers- the terms in whic the *Saturday Review* described the press reports of tl Oxford meeting of the British Association. Yet there is now less justification for this criticism than formerly, since recently the Press, taken as a whole, has progressively improved its performance in separating the grain from the chaff. Many of the principal newspapers now have at their disposal the services of journalists who are also scientific writers of distinction. Tl daily reports of the Oxford meeting in the principa London and provincial journals were fuller than eve before, and considering the circumstances in which they were compiled, remarkably fair and accurate. Naturally, newspapers like the *Times* can devote more columns to the proceedings than those in the class typified by the *Daily Express* and the *Daily News*, but little exception could be taken to the reports as a whole. They flattered the intelligence of their readers. Moreover, many of these journals maintained a running fire of comment in leading articles on the more important papers delivered, a striking commentary on the interest in science which the meeting provokes.

There is little doubt that this interest could be sustained. The *Daily Express* published recently a series of articles by eminent scientific workers. Most

of the serious weekly periodicals devote some space to scientific subjects. The day cannot be far distant when the editors of the *Observer* and the *Sunday Times* will make a science page as regular a feature of their papers as their literature, music, and dramatic art pages. It is not improbable that the demand for scientific information is great enough to justify the publication of a science daily newspaper, or at least a sound and popular science weekly, written in a form calculated to appeal to a wider public than NATURE. There are daily and weekly journals devoted to finance, and these are not read solely by professional financiers.

The steps which might be taken by scientific workers to satisfy the public demand for knowledge of their work have already been the subject of comment in these columns. Reference has also been made to what has been done in the United States, by scientific workers themselves, to deal with a like situation. It is obvious that where there is a demand it will be satisfied by somebody. If the scientific community in Great Britain wishes to safeguard itself against the kind of misrepresentation of its endeavours which masquerades in the guise of 'popular science,' if it wishes to safeguard those members of the public interested in science progress against exploitation by enterprising advertisement agencies, there is no time to be lost. The opportunity to give the best of science to the nation exists. Do scientific workers possess the will and energy to take advantage of the present favourable situation?

The Electricity Bill.

THE Electricity Bill, after passing its third reading in the House of Commons, is now being considered in the Upper House. As there were twenty-six pages of amendments to be discussed and the bill is of a highly technical nature, the task was no easy one, but it started auspiciously. In the committee stage the bill was discussed from almost every point of view, and so it is unlikely that any serious flaw has been overlooked. Many politicians think that this bill makes a long step in the direction of nationalisation. In the opinion of the Government, however, it will stop nationalisation. It is pointed out that the electric supply industry is on a quite different footing from other industries. In every district of Great Britain electric supply is a monopoly. It is urged, therefore, that the industry should not be deprived of the great benefit that would ensue when co-operation and centralisation replace individual effort. The need for passing the bill at once is imperative, as several schemes for developing electrical supply are being held up pending the new legislation.

The amendment adopted by the Government making it obligatory instead of permissible for the Electricity Board to advance free of interest such sums as might be necessary to enable authorised undertakers or owners to alter their frequency, will probably meet the chief objection of many opponents of the bill.

It will be remembered that the origin of the bill was the desire expressed by many engineers to increase the interconnexion of networks of electricity supply in Great Britain. The primary object of the bill was to increase the efficiency of the supply. It will probably follow that an increase in the retail supply and a lowering in the price of electricity will take place concurrently. In Canada and the United States there are huge supply networks covering many thousands of square miles. The Pacific Gas and South Californian Edison Companies network covers 120,000 square miles and links up 130 stations, which is more than double the area covered by the Government scheme.

The Electricity Commissioners have pointed out that 56 per cent. of the capital of electricity undertakings is locked up in spare plant. If complete interconnexion were established, this could be reduced very considerably. This is one of the principal gains which the promoters of the bill hope to secure. In due time considerable savings will doubtless be effected, and care has been taken to ensure that the consumer will benefit largely by them.

In our opinion this scheme will be a boon to both the country and the industry, provided that no undue delay ensues before it is put into operation. A really forward policy need not involve large expenditure. The Electricity Commissioners' Reports prove conclusively that many of the electricity networks in Great Britain are inadequate and were very expensive to construct. In some cases the cost per unit of maximum demand is about twenty times as great as that of the most efficient stations. The multiplicity and variety of the systems of supply in London, although largely due to early electrical legislation which established two competing companies in each local area, is not creditable to electrical engineers. Figures have proved the great economies that could be effected without even the necessity of scrapping plant the efficiency of which is only fair. A first step in the direction of improvement has been the standardisation of the pressure of supply. Whenever new schemes have been sanctioned or systems changed from direct current to alternating current, or even in those cases where direct current is being retained, the pressure of supply is now 230 volts.

We are glad to see that progress is being made by electrical manufacturers in the direction of cheaper

systems of distribution in rural districts. Every one, who has travelled on the continent knows the extensive use that has been made of overhead electrical distribution, particularly in connexion with railways. Whether they spoil the view of the landscape or not, there can be no question but that the use of poles, whether of wood or iron lattice work, is a great boon to the various countries concerned. We hope that the collieries and iron and steel works in Great Britain which do not generate their own electricity will be able to secure a bulk supply at low rates when this bill is passed. We also hope that those firms which can generate from waste heat more than sufficient power to meet their own needs will benefit by being able to sell their excess power to the Electricity Board.

The Mystery of Money.

Wealth, Virtual Wealth, and Debt: the Solution of the Economic Paradox. By Prof. Frederick Soddy. Pp. 320. (London: G. Allen and Unwin, Ltd., 1926.) 10*s.* 6*d.* net

IN childhood many things are hidden from us, but we use money to buy our first sweets at an age which is rarely within the recollection of mature thought. So we take money for granted. We learn by experience that it procures the things we want, and that usually seems to be all we want to know about it. Its origin, its functions, the explanation of the ebb and flow of its command over goods, with an accompanying maldistribution of unearned gain and undeserved loss, are, if not entirely unknown phenomena, at least recondite subjects which are best left alone.

Prof. Soddy is, however, a more adventurous spirit. After achieving a position of distinction in his own sphere which would satisfy the ambition of most men, he has become intrigued with the elusive problem of money. So we have "an attempt, rarely made nowadays, by a specialist in one field of knowledge to solve the problems in another."

Prof. Soddy has produced a volume which contains at one and the same time a penetrating analysis of the ultimate realities of modern banking science and a new theory of money which, despite his assertion that the solution which he brings is "the most ordinary incontrovertible commonsense requiring nothing more than that to prove it," will be rejected by every student of economics.

In the preface the reader is encouraged to read the conclusions in the last chapter before he commences on the arguments in the book. He could economise his time still further by skipping the very interesting but irrelevant matter in the first 100 pages, because it is not until Chapter vi. that the author comes to grips with his first concept of wealth. In this chapter, which bears the heading of "The Two Categories of Wealth," the first section has the sub-title of "The Nature and Definition of Absolute Wealth," and we have to assume, in the absence of any clear indication, that his definition lies in the concluding words, which read: "Wealth as a form, product, or result of a draft upon the flow of available energy consists of the special forms, products, or results which empower and enable human life." After careful study we doubt whether this definition will jump readily to the minds of "all serious readers sincerely anxious to understand the causes of modern unrest." The theme, however, is further developed and two main categories of wealth distinguished. The first includes commodities "which retain part of the energy expended in their production, as an internal store, which, in the consumption of these commodities, is released to serve the purposes of life." The second category includes commodities of which "the energy is expended in overcoming dead resistance, in changing the form or nature of the materials worked upon, and does not remain in the materials as an essential to their use." As examples in the first category we are given food, fuel, explosives, etc., and in the second, clothes, houses, furniture, tools, plant, roads, vehicles, and ships. The difference lies in the relative perishability of those in the first category contrasted with the relative permanence of those in the second. So we reach the distinction, familiar to the economist, between consumers' goods and producers' goods— a distinction which Marshall characterises as "vague and perhaps not of much practical use" ("Principles," II., III., 1).

The meaning of the new term "Virtual Wealth" is not made easy. Prof. Soddy tells us that "the important thing is that this Virtual Wealth does not exist." 'Money,' although nowhere defined, apparently includes gold and silver coins, bank notes and cheques; we assume the latter term to mean all bank balances. Gold in the form of bullion is part of the national wealth; in the form of coins in circulation it is condemned as representing a waste of the community's labour. The system of bank balances is described as a power conferred upon the owners of those balances "not to possess but to be owed wealth." From this it is deduced that money is not wealth, but evidence that the owner of the money has not received the wealth to which he is entitled—wealth which he can demand at his convenience. It follows that "in a community, of necessity, the aggregate money, irrespective of its amount, represents the aggregate value of the wealth which the community prefers to be owed on these terms rather than to own. This negative quantity of wealth I term the *Virtual Wealth* of the community, because the community is obliged . . . to act as though it

possessed this much more wealth than it actually does possess."

The trained student, to say nothing of the ordinary reader, will not find the argument very lucid, especially when he reads, on a later page, that "Virtual Wealth has, in fact, very little to do with the quantity of money." The author does not seem to realise that both in their private and business lives people retain floating balances of money (in the house, office, or bank) because it is a convenience to do so. The custom rests upon an economic basis; balances so kept perform a useful service. But the real object of Prof. Soddy's attack is the creation of bank money, which proceeds from the mechanism of banking operating through the extension of credit resting upon a gold basis. With an increase in 'cash balances' of 100*l.* and a cash ratio of 15 per cent., it is possible, he notes, to create deposits to the extent of 666*l.* 13*s.* 4*d.*, this liability being balanced on the assets side by the 100*l.* of original cash plus 566*l.* 13*s.* 4*d.* of advances. In this manner additional purchasing power is created, and Prof. Soddy says that if the total advances tend steadily to increase, people are undoubtedly "empowered by the banks to acquire wealth temporarily from the community to which they were not entitled and for which the whole community paid."

The author asserts that the financial device of the cheque for economising the use of currency means that a complete and unsuspected alteration has come over the nature of money. It may be complete, but it is surely going too far to imply that it is unsuspected by any one familiar with monetary science. In the ordinary course the growth of credit is small and gradual. It is controlled in all communities using the gold standard by that standard. Viewed impartially, the cheque system joined with the expansion of credit has been a blessing and not a curse. On the other hand, the multiplication of credit by the banking system during the War years, and immediately afterwards through the increase in the cash basis provided by the withdrawal of gold from circulation and the substitution therefor of Treasury notes, did bring into being a mass of purchasing power which was acquired from the community as a whole through the depreciation in sterling. In one word, we had inflation, and undoubtedly inflation was profitable not only to manufacturers, merchants, and traders, but also to the bankers. Views may differ as to the necessity of this operation, but few will now be found to hope that it is possible, as Prof. Soddy would wish, to put the clock back.

Prof. Soddy contends that "something of the order of two thousand million pounds have been created by the banks," which at 5 per cent. brings them in a revenue of a hundred million. His remedy is that the State should "buy back in the open market £M2000 of War Loan with genuine new money to replace that created by the banks." It is not clear how this money is to be issued. In one place we are told it is unnecessary to issue this quantity of Treasury notes and put them in circulation; three pages later we learn that this new money has in future to be held by the banks. Debtors to the banks in respect of present advances must, under this scheme, either sell their securities or find some one who has fresh money to lend them in order that they may repay the banks, which in future are to be required to lend only genuine deposits and are to be forbidden to extend credit upon the principle of keeping only in their tills a safe proportion of deposits.

The precise manner in which these proposals are to be executed is not specified. If contact and trust can be established between repaid National Debt holders and debtors to the banks so that the former lend to the latter sufficient to repay the banks, this part of the scheme might work in theory. The hypothesis, unfortunately, rests upon unexpounded assumptions which will not bear a moment's examination. The new money would unquestionably be paid into the banks, to the credit of the repaid National Debt holders as depositors. Now the banks are in future to keep pound for pound against deposits. We are at a loss to understand how they can do so and still "lend money at interest as before." If they keep cash pound for pound against deposits, they can earn no interest, and the whole credit structure, with all the assistance it renders to industry, will be brought to the ground. Further, how are the debt holders who are to be penalised by the redemption of their stock in new currency to be selected? If impartially, then the innumerable changes that have taken place in the ownership of debt holdings necessitate nothing less than a capital levy. In truth, Prof. Soddy's real plea is for the nationalisation of banking. But just as he shirks the issue of a capital levy, so he omits to carry his other proposals to their logical conclusion.

In the latter half of his book the author concentrates on the problems of the monetary factor in relation to production, and argues in favour of a stable price level controlled through the medium of a national statistical office. Control of currency is, however, to be in the hands of the State. As production increases, new money is to be printed and issued to the consuming public, by meeting Government expenditure therewith instead of by taxation. We are told that the correct quantity of money is that which is sufficient at the stable level of prices to purchase the total stocks of finished wealth in and outside the industrial system. No attention is given to the special circumstances of

Great Britain as an exporting country. We are left wondering how we are to have a stable price level—presumably upon a gold basis—kept in proper relation to the price levels of other countries upon a like basis, if the export trades optimistically expand their output despite the absence of foreign buyers at the prices current, and if floods of new currency are issued by the State *pari passu* with the optimism of the producer.

While we have every sympathy with the difficulties that Prof. Soddy has found in the full comprehension of our present monetary system, we fear that his remedies would involve evils and difficulties far worse than those from which we at present suffer.

W. H. COATES.

Venereal Disease.

Proceedings of the Imperial Social Hygiene Congress, Wembly, Oct. 1925. Pp. iv+301. (British Social Hygiene Council, Carteret St., London, S.W.1.) 4s.

THE report of the Imperial Hygiene Congress deals exclusively with venereal diseases. Formerly all diseases were regarded as 'trials,' or as 'punishments for sin.' To-day only venereal diseases are so regarded, and only by the least civilised. It is known that they are caused by microbes, and that microbes do not discriminate between the just and the unjust. Nevertheless, even in England, and even so lately as during the War, after lectures compulsorily attended by soldiers, the jest that "It cannot, then, be sinful to have intercourse with virgins and respectable married women" was not uncommon. The silliness of these lectures is realised when it is borne in mind that among the sufferers are millions of infants.

Diseases may be prevented, or they may be cured. Cure is not an hygienic measure of importance. At any rate, the prevalence of no disease has been reduced appreciably by mere cure. Hygiene *is* prevention, which implies some effective form of cleanliness. Thus, diseases of the alimentary tract (*e.g.* cholera, typhoid, and dysentery) are prevented by attention to the food and water supplies. Insect-borne diseases (*e.g.* malaria, typhus, yellow fever, and bubonic plague) are prevented by destroying the insect carriers. Contagious diseases, such as most skin complaints, can be prevented only by personal hygiene.

The venereal diseases are strictly contagious. They have certain peculiarities. In the vast majority of infections, man is the carrier for woman and woman for man; that is, if they be prevented for one sex, they are automatically prevented for the other. As a very general rule, infection occurs only on particular occasions and on particular parts of the body. The microbes are very delicate, and therefore destructible by ordinary disinfectants if the latter be employed soon after the danger has been incurred, while the microbes are yet on the surface of the body. The male is much more easily disinfected than the female—so easily that a child might perform the operation which consists in no more than the swabbing of a few inches of very accessible skin. Lastly, the venereal diseases are the only maladies with which morality is now concerned.

Two methods of prevention are in vogue: exhortations to morality, and the use of chemical disinfectants. No one has objected to the exhortations; but the use of disinfectants has been much opposed. It has been forgotten that cleanliness is next to godliness. Exhortations to sexual morality, though used for many centuries, have not been very effective at any time. A point of psychology is involved. The sexual inclination is an instinct—a mental impulse to action which is awakened by experience, but not created by it. Thus no one *learns* to be hungry, or thirsty, or to suck. All human instincts are the same for all races of men. On the other hand, morals differ with time and place. They are learned. They constitute the rules by which men restrain their instincts and play the game of society. Almost invariably they are acquired at a particular age and in a particular way—during childhood and by imitation. A little child is 'plastic' (*i.e.* imitative), and therefore tends to copy the emotional convictions of its associates.

Consequently, a child can learn with sincere and unquestioning belief the tenets of any religion and its associated system of morals. In later life this power of learning through imitation becomes greatly enfeebled. The adult learns more through evidence; or what he supposes is evidence, for his judgment is often warped by preconceptions acquired during youth. Thus, while the child of ardent Mohammedans or Hindoos may be brought up in any religion and system of morality, it is usually impossible to change the opinions of the parents. In Christendom, and especially among English-speaking peoples, it is remarkable that exhortations to sexual morality are usually delivered by adults only to adults. Consequently, children learn their sentiments from other children among whom a knowledge of sex is traditional. It follows that exhortations to sexual morality delivered to adults are usually very ineffective—as any reader of NATURE may judge from his own feelings. Would any amount of preaching alter his present sentiments?

Prevention by means of chemical disinfectants has been practised for many years, and on a large scale during, and since, the War. During the War, precise statistics, every item of which could be checked from

official records, were available. It was demonstrated that in many instances, under many and diverse conditions, in many parts of the world, high venereal rates had been reduced almost to the vanishing point by means of immediate disinfection practised by the endangered persons themselves. These facts were unpalatable to people whose principal concern was sexual morality. They could not bring themselves to believe, and sought to create unbelief. But the evidence has been examined by several committees of inquiry, and found unassailable—for example, Lord Trevethin's committee. To-day the only people who insist that personal disinfection is valueless are those who, on moral grounds, have refused to advise it, and therefore have no experience of it.

During the proceedings of the Imperial Hygiene Congress there seems to have been general agreement on two points: public sexual immorality had increased, and the prevalence of venereal disease had diminished during recent years. The conclusion to which we are driven is very obvious. Exhortation has had little influence and disinfection much.

The opening address of the Congress was delivered by Mr. Amery, Secretary of State for the Dominions and Colonies, who stated:

"Now we are dealing in this Congress more particularly with a certain aspect of health, and with certain types of diseases. We are dealing here with a problem that is at once one of the most serious and one of the most hopeful to which any body of public workers or reformers can devote themselves. Most serious, because I think it is becoming increasingly realised how wide-spread, how appalling in the misery, suffering, waste of human life, strength and ability they cause, are the consequences, direct and indirect, of venereal diseases. On the other hand, hopeful, because from the medical point of view there can be no doubt that under the conditions of modern science there is no range of diseases which is more obviously and definitely capable of being dealt with, of being cured, and, indeed, if public opinion was strong enough, capable of being extirpated."

In effect, the only reference to chemical disinfection was made by Surgeon-Commander Thomas Shaw, professor of hygiene in the Royal Naval Medical School, Greenwich, who declared:

"As stated by Trotter one hundred years ago, the best means of preventing venereal disease, if promiscuous sexual intercourse is indulged in, is immediate disinfection of the parts. The part played by suitable and immediate prophylaxis is no longer disputed by any responsible person, and as promiscuous sexual intercourse will still continue to be practised by certain people in spite of all efforts to the contrary, our only hope of eventually exterminating venereal disease altogether is by a wider application of this measure. Whilst we all recognise the great importance of social measures in combating venereal diseases, we shall never exterminate them by these means alone."

The remainder of the volume recording the proceedings is occupied with accounts of the prevalence of venereal diseases in the British Empire, with descriptions of measures taken to cure people already infected, and of narrations of attempts to preserve sailors and other plastic types from the sirens of the streets.

The word hygiene does not accurately describe the Congress.

The Biology of the Protozoa.

The Biology of the Protozoa. By Prof. Gary N. Calkins. Pp. 623. (London: Baillière, Tindall and Cox, 1926.) 35s. net.

ALTHOUGH during the last quarter of a century the study of protozoa has been vigorously pursued by many students in many lands, yet the bringing together of the results so obtained, and the critical analysis of often discrepant results, is long overdue. The well-known text-books by Minchin and Doflein to a certain extent fill this need, but one is largely concerned with parasitic forms of protozoa, while the other is not available to those not conversant with the German language.

Moreover, as Prof. Calkins says in his introduction, "protozoology as a branch of the biological sciences has meant little more than the application of biological or zoological methods to a definite but limited group of organisms, the Protozoa." The author has therefore tried to weave the many aspects of protozoological research into a common whole, with the hope of so founding a science of protozoology. The underlying principle of the work is the irritability of protoplasm, combined with protoplasmic organisation. Keeping this fundamental fact in view, the various characteristics of these unicellular animals, namely, metabolic activities, asexual and sexual reproduction, reorganisation and restoration of organisation, etc., are considered.

The word 'unicellular,' as applied to these animals, reminds one of the much-debated point as to whether 'non-cellular' is not a better designation. Prof. Calkins points out that, whereas a single protozoon is to be compared structurally with a single isolated tissue cell of a metazoon, it is a different unit physiologically, and as such should be compared with a complete organism, as was pointed out by Whitman, and later by Gurwitsch, and Dobell.

The book is divided into twelve chapters, covering a wide range of the subject; the first five chapters treat of the general organisation of the protozoan body, nuclei and kinetic elements, structural differentiations, general physiology, and reproduction. This is followed by chapters dealing with each of the big

subphyla of the protozoa: Mastigophora, Sarcodina, Infusoria, and Sporozoa. The classes of each of these groups are described and useful keys to the common genera are given. The concluding three chapters are perhaps the most interesting, for the author discusses such questions as vitality, fertilisation, and the origin of variations.

In a book of only about six hundred pages it is obviously impossible to treat exhaustively this subject matter, and the author has been wise in concentrating more upon free-living protozoa, to the exclusion of the parasitic types, as for example in the chapter on structural differentiations. Here little or no mention is made of the many curious adaptations incident upon the adoption of parasitism; since, however, these have already been well described, the account given by Prof. Calkins of the modifications found in free-living protozoa is particularly welcome.

Under the heading nuclei and kinetic elements, the author has grouped together, in a clear and interesting way, the various organs and cellular elements associated with movements, together with a description of the different configurations grouped together under the term nucleus. To the general biologist the section devoted to kinetic elements will probably appeal most strongly, for it is comparatively few who realise how complex is such a seemingly simple structure as a flagellum or cilium; added to this the reader is introduced to the numerous cytoplasmic granules known as endobasal bodies, centrioles, blepharoplasts, parabasal bodies, etc., all of which appear to play some part in the physiology of movement.

Particular attention may also be directed to the advances recently made towards elucidating the question of co-ordination in protozoa. Sharp, Yocom, McDonald, and others have been able to show that a definite conducting system of fibrils exists in many species of ciliates and that this system emanates from a common mass of protoplasm—the motorium—constituting with the fibrils a 'neuromotor' apparatus. Fig. 57 of Calkins' book illustrates this apparatus in *Euplotes patella* and goes far to substantiate the view that a single protozoon must be regarded as physiologically comparable with a whole metazoon individual.

The chapter on general physiology does not attain the high character of the rest of the book. This is unfortunate, since the title of the volume would suggest that physiology was particularly stressed; and, moreover, there is no modern book dealing with this branch of protozoology which can be recommended to the student. Prof. Calkins' book does help to fill this need, but not completely. In a future edition he would probably be well advised to expand this section to two or three times its present dimensions, even at the expense of some of the other material. The author has evidently been at pains to keep his book within reasonable limits, with the result that sometimes his treatment is a little sketchy; thus little space is given to the questions concerning the response to various stimuli, and little or no mention is made of the reactions brought about by changed environmental conditions or adaptation to new conditions. Again, the important phenomena of encystation and excystation are not adequately discussed. The author has committed himself to the view that external conditions do not play a predominant part in causing the former reaction—a view to which most students of protozoa will subscribe—but the results of the many modern experiments are not given.

A similar criticism may be made against the treatment of nutrition, for, while certain aspects of it are well described, it is a surprise to find such a fascinating subject as choice of food dismissed quite summarily, without even mention being made of the work of such men as Oehler, to give only one example.

Probably the chapters to which all biologists will at once turn are those dealing with vitality; the author means by this term "the sum total of actions, reactions, and interactions between and amongst the substances making up the organisation of protoplasm, and between these and the environment." As is well known, Prof. Calkins, as a result of many years' research, has arrived at conclusions regarding the significance of conjugation and the part it plays in the life cycle of ciliates different from those of other distinguished observers.

The experiments on which these views are founded are well recounted; and to-day Prof. Calkins maintains the following conclusion: "To my mind the phenomena in these forms lead to the conclusion that Protozoa and Metazoa are fundamentally alike in respect to protoplasmic continuity and protoplasmic death, the difference between them is bound up with our definitions of the individual. So far as immortality of Protozoa is concerned, Hertwig's (1914) conclusions appear to sum up the situation: 'However these investigations may turn out, one may say this now, that the doctrine of the immortality of the Protozoa in the form established by Weismann, at a time when we did not know anything of the fertilisation processes of the Protozoa, cannot be retained.'"

The author must be congratulated upon the production of an exceedingly useful and interesting book; and in conclusion the hope may be expressed that at a future date he will furnish us with a more extended account of the general biology and physiology of that group of animals to which he has given thirty years' research.

D. WARD CUTLER.

Our Bookshelf.

Cotton and its Production. By W. H. Johnson. Pp. xxvii + 536 + 16 plates. (London: Macmillan and Co., Ltd., 1926.) 30*s.* net.

THE author has evidently utilised his very extensive experience of cotton-growing in most parts of the world to guide him in compiling this substantial volume from documentary sources. The result is a useful addition to the books about cotton, for besides being well up-to-date it is well balanced and exceptionally free from errors of fact. The author's first-hand knowledge puts his treatment on a higher level than mere compilation, but it is in no sense a critical treatment, and only attempts to present the known or reputed state of affairs. He deals with cotton production throughout the world, taking the information available with discretion.

The general level of the agricultural chapters which deal with the different countries is very fairly maintained in the others. Such subjects as the history and botany of the crop, its manufacture and by-products, its pests and diseases, all receive a chapter each, and these chapters are not likely to mislead the student, but will serve as useful introductions to further study.

Seeing that the scope of the book is such as will serve for reference purposes as well as for general information, it is regrettable that the system of references is very irregular. The "bibliography of cotton" which figures in the table of contents only contains some fifty items, apart from lists of journals and reports; some of these few are merely of casual interest, while others have not been used in the text. Conversely, there is internal evidence for the use of many publications which are not cited, as in the chapter on manufacture. Having regard to the skill with which the author has built up these citations into readable matter, and the great number of sources from which he has drawn them, it is to be hoped that the next edition will be lavishly provided with footnotes. An alternative course would be to issue a thin supplement volume of such references.

The details open to criticism are unimportant, and in most cases are due to the authority cited, for which the author has become responsible; thus the paragraph concerning the reputed depreciation in length of Sakel is very misleading, and the possibilities of rain-grown cotton in the Sudan, as regards quantity, are neglected more than the descriptive treatment warrants.

W. L. B.

Dairy Cattle: Selection, Feeding and Management. By Prof. William Wodin Yapp and Prof. William Barbour Nevens. (Wiley Farm Series.) Pp. xvii + 378. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1926.) 11*s.* net.

THIS book deals with the selection, feeding and management of dairy cattle on the lines which the authors consider suitable for vocational-school students and dairy farmers in the United States. The subject matter of the different chapters is generally well known to the writers and workers in dairy husbandry in Great Britain and does not require special mention, but the method of study recommended in each chapter is novel and characteristic of the organisation and attention to detail which is possible in agricultural educational work when there is a staff sufficiently large to permit of the division of each subject into numerous sections.

The method adopted by the authors is that of stating clearly at the commencement of each chapter the practical operations involved; thus in the chapter on "Improving the Dairy Herd" the operations specified are: (1) Eliminating the low-producing cows; (2) choosing the proper sire; (3) practising rigid selection.

Each operation is then considered and the procedure to be followed is set out concisely in appropriately headed paragraphs. This method appears excellent, and has the merit of at once attracting the attention of the reader to the main points which the writers wish to emphasise. At the end of each chapter is given a list of American text-books and bulletins to which the reader may refer for further information; also a series of questions is set out, and the student is advised to obtain answers for himself by visiting a number of dairy farms. The advice given throughout is excellent, but amid so much attention to detail it is strange that the fundamental dairy farm operation of milking is passed over in a few words, and that in taking composite samples of milk for fat testing no mention is made of the need for the amount of the sample to be proportionate to the quantity of milk from which it is taken.

The book will be interesting and helpful to the lecturer in dairy husbandry in Great Britain who does not already possess an American text-book, but its value to the British student and farmer is limited because the numerous breeds of dairy cattle and kinds of feeding stuffs common in England but little known in the United States are not referred to by the authors.

Les mollusques d'eau douce. Par Prof. E. Chemin. (Encyclopédie pratique du naturaliste, Tome 24.) Pp. viii + 186 + 15 planches. (Paris: Paul Lechevalier, 1926.) 25 francs.

THIS little manual is one of a kind common in France, but only too rare in England, in which a circumscribed portion of some branch of natural history is treated by itself, be it from an elementary or from an advanced point of view. As a matter of fact, this one is more restricted than usual, for while its title would lead one to expect a complete account of the freshwater molluscs, at all events of France, the author announces in his preface that such is far from his intention. He writes, he says, merely for those who are interested in the natural sciences and the marvels of Nature, and his method is to select a common, characteristic form from each genus and describe its salient features, external and anatomical, so far as they can be explored without serious dissection. Comparisons are drawn between these genera, and their relationships to the bigger groups which they represent are outlined.

All this is admirably done, and the explanations are thoroughly clear and as good as any we have seen. On the other hand, in common with many who rest in the biological stage and are incapable of developing into the higher one of zoologists, the author gives vent to his contempt for the systematic side of his subject, and his sole contribution is to append to each generic description brief remarks on, or sometimes only the names of,

the species he includes under it. He has evidently no first-hand knowledge of this branch of the subject, and his statements are antiquated and sometimes erroneous, as for example when the names of *Unio pictorum* and *U. tumidus* are interchanged. Fifteen plates depicting these species are appended to complete the book. Four are in gaudy, unnatural colours, the remainder in bistre half-tone, based principally, it would seem, on photographs, and for the most part devoid of their characteristic surface-markings or sculpturing.

Animal Husbandry. By H. J. Waters and F. G. King. Pp. viii + 546. (Boston, New York and London: Ginn and Co., 1925.) 7s. 6d. net.

No phase of agriculture has made more distinct advance within the last century than that which relates to the care and management of domestic animals. Certainly no other makes quite so attractive an appeal to human nature. This may explain the numerous text-books on this subject which appear from time to time. In one of the latest of these, by means of a judicious interweaving of theoretical principles and sound practical instruction, Messrs. Waters and King have succeeded in promoting that degree of co-ordination which should exist between the science and practice of stock farming.

A well-marked feature of the book is the attention devoted to the improvement in live-stock production, emphasis being laid on the attainment of the breeder's ideal through years of judicious selection and the vigorous culling of the scrub animal. It is pleasing to see that a few chapters are devoted to the encouragement of boys' and girls' clubs. This movement originated in the United States and has now assumed very large dimensions; doubtless it has been a factor of considerable importance in the general advancement in live-stock production. Useful hints are given regarding the formation of such clubs and what should be the ideals of club members.

We are of the opinion that the sections relating to the nutrition of the farm animal might have contained somewhat more detail. However, considering the size of the volume, the authors appear to have covered the ground with remarkable thoroughness.

The whole work is well produced (there are many beautifully reproduced photographs to illustrate the text), and should serve as an introductory or intermediate text-book for rural economy classes in schools and colleges.

Bibliographia Genetica. Onder redactie van Dr. J. P. Lotsy en Dr. H. N. Kooiman. Deel 1. Pp. v + 462. ('s-Gravenhage: Martinus Nijhoff, 1925.) 25 guilders.

DR. LOTSY and Dr. Kooiman have undertaken the task of editing this work, the first volume of which appeared last year. In a series of volumes, contributed to by geneticists from all over the world, it is intended to summarise the whole field of modern genetics. The enormous and rapid development of genetics, which began in 1900 and is still going on at an increasing pace, makes such a series of summaries very valuable to workers in this field and to those who wish to know the present state of the subject without looking up the original papers. Each author covers the field in which his own contributions figure most prominently.

Thus in the present volume of 460 pages we find Fritz von Wettstein summarising—in 38 pages—the genetical work on mosses, including his own important work on polyploidy in these forms. Similarly, Punnett takes up the genetics of the sweet pea, giving a chromosome map of the various linkage groups; Castle deals with rabbits and guinea-pigs, with illustrations of the more important types; Fruwirth sets forth in 48 pages the genetic results on the potato, and Lehmann in 56 pages those with Epilobium.

Of somewhat different character is Haecker's "Aufgaben und Ergebnisse der Phänogenetik," which occupies 222 pages and is divided into eight chapters, dealing with such topics as size and its inheritance, asymmetry, pigmentation, skull shape, etc., in a comparative way.

Each contribution ends with a list of literature and an index which places all the information in the most available form. The volumes are well bound and should find a place in every productive biological library. R. R. G.

A Course of Geometrical Analysis. By Dr. Haridas Bagchi. Pp. xi + 562. (Calcutta: Chuckervertty, Chatterji and Co., Ltd., 1926.) 20 rupees.

IT is evident from this book, which is concerned with differential geometry, that Dr. Bagchi knows a great deal of mathematics and that he is a charming man, but it is equally clear that he would have been well advised not to publish this work in its present form. It consists of a kind of commentary or gloss on Forsyth's "Differential Geometry," to which the author makes handsome acknowledgments—see in particular on p. 228 the disarming way in which he ventures to point out a misprint. He deals at great length with rather elementary and trivial points, referring to Forsyth for the serious algebra and for the explanation of his terms, so that the book is unintelligible by itself. There are long digressions on such matters as homogeneous functions and Jacobians, in which the author has really nothing to say which should not be well known to any one beginning the subject. In fact, the book would be intolerably prolix and quite unreadable were it not for the delightfully quaint turns of speech which are to be found on every other page, but from which, in spite of the temptation, we refrain from quoting. Twenty rupees is a large sum to pay for this kind of amusement; after all, Mr. Anstey has done it quite as well long ago. It is a great pity, because Dr. Bagchi is undoubtedly capable of doing good work in mathematics, if he would not spread himself so much.

Kleines Praktikum der Vegetationskunde. Von Dr. Friedrich Markgraf. (Biologische Studienbücher, 4.) Pp. v + 64. (Berlin: Julius Springer, 1926.) 4·20 gold marks.

DR. MARKGRAF's introduction to the practical study of vegetation is chiefly of interest because of a somewhat detailed consideration of the use of the quadrat method in the field, illustrated especially by reference to bogs and woodlands. This occupies nearly half the volume and, by comparison, the second section dealing with methods of investigating the features of the habitat appears all too brief, even for a beginner.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Continuous Spectrum of Mercury.

IN recent papers I have discussed the continuous spectrum of mercury and its association with the resonance line λ 2537. Prof. R. W. Wood showed in 1909 that the green visual fluorescence of mercury vapour with continuous spectrum was destroyed by a red heat. I have recently studied the effect of heat on a stream of mercury vapour, showing the continuous spectrum as it distilled away from the electric discharge in which it originated. The visual glow disappeared, as might be anticipated from Wood's result. I thought it very probable that this was to be explained by the dissociation of mercury molecules which give rise to the (apparently) continuous spectrum. It was of interest to see whether the resonance line due to the atom would survive.

Photographs of the ultra-violet spectrum taken with these ideas in view gave a very surprising result The resonance line *did* survive, but with it was the strong part of the continuous spectrum in the region λ 3300, little if at all affected by the heat This surviving part of the continuous spectrum is separated by an intervening minimum from the visual region which *is* extinguished by the heat.

There is much more to do. I limit myself for the moment to announcing the above, which has been thoroughly confirmed.

RAYLEIGH.

Terling Place, Chelmsford,
November 14.

The Golgi Origin of Fatty Yolk in the Light of Parat's Work.

DURING the last few years evidence has been steadily accumulating that the Golgi rings or crescents of certain eggs give rise to fatty yolk. As this conclusion has been challenged by certain authors (for example, Harvey, *Quart. Journ. Micr Sci.*, 1925), it seems to me desirable to set forth briefly the evidence in favour of the above view in the light of Parat's work, which lends strong support to it.

To the best of my knowledge, Hirschler (*Zeit. f. Wiss mikr. u tech*, 1915) was the first worker to describe, in the eggs of ascidians, a swelling of the Golgi elements and their fusion with the swollen mitochondria to give rise to compound yolk bodies. This conclusion has been recently supported by Parat and Bhattacharya (*Comptes rendus*, 1926), who have studied the eggs of Ciona by means of Vital dyes. The greater bulk of evidence in support of the Golgi origin of fatty yolk, however, has been furnished by Gatenby and his pupils, and more recently by myself. In the egg of Saccocirrus (Gatenby, *Quart. Journ. Micr. Sci.*, 1922) the juxta-nuclear Golgi apparatus spreads out and proliferates with the growth of the egg, and probably gives rise to granules which are fatty in nature. A similar process has been described by me (*Proc. Camb. Phil. Soc.*, Biol. Sci., 1924) in the eggs of Lithobius, in which the granules that arise from the proliferation of the Golgi apparatus grow to a considerable size and form fatty yolk which comes up in the centrifuged eggs exactly like the fatty yolk of Saccocirrus. In Helix (Brambell, *Brit. Jour. Exp. Biol.*, 1924) some of the Golgi elements are directly metamorphosed into fatty yolk which occupies the upper pole in centrifuged eggs. In Patella, Ludford (*Jour. Roy. Micr. Soc.*, 1921) and Gatenby and Woodger (*Jour. Roy Micr. Soc.*, 1920) give a very circumstantial and convincing account of the origin of fatty yolk from the Golgi elements which has more recently been confirmed by Brambell (*Brit. Jour. Exp. Biol*, 1924), who shows that the fatty yolk occupies the upper pole in centrifuged eggs as is the case in Saccocirrus, Lithobius, and Helix.

During 1924 and 1925 Parat and his collaborators (*Comptes rendus des Séances de l'Académie des Sciences* and *Comptes rendus des Séances de la Société de Biologie*) have published a large number of small papers giving the results of their study of the Golgi apparatus in the genital and somatic cells of both invertebrates and vertebrates. This is not the place for a full discussion of Parat's view. According to Parat, the Golgi elements exist in the form of vacuoles in all vertebrate and invertebrate cells. This he has proved by the use of the Vital stain, neutral red, the crystals of which precipitate in the vacuoles while the mitochondria remain quite colourless. These latter, however, can be stained by the application of Janus green. Vacuole-like or ring-like Golgi elements are of course very common even in fixed preparations of all the cells of invertebrates and the genital cells of vertebrates. The important contribution, however, that Parat has made is that even the network-like Golgi apparatus of the somatic cells of vertebrates really consists of vacuoles. The reticular appearance of the Golgi apparatus is, according to Parat, an artefact produced by the precipitation of metallic silver or osmium in the interior, or at the periphery, or between these vacuoles.

As the somatic cells arise by differentiation from the germ cells, and as undoubtedly the Golgi elements of a particular cell are roughly distributed to the two daughter cells during mitosis, it has been so far difficult to explain how the Golgi crescents or rings of the germ cells could give rise to a network found in the somatic cells of vertebrates. As to the contents of the vacuoles, Parat insists that they are not lipoidal, because osmic acid is the test for fats and not for lipoids The content is mostly a liquid and its reaction is acidic; hence the affinity of vacuoles for the basic neutral red. The absence of coagulum leads us to think that we have to deal in the majority of cases with the solution of crystalloids. But it is a fact that certain colloids not miscible with protoplasm can accumulate in the vacuoles, like aleurone grains in the vegetable cells. Final judgment on the chemical nature of the Golgi apparatus, however, can be delivered only when we are able to analyse it chemically, as has been done in the case of nucleo-proteins, but the view that the Golgi apparatus really consists of vacuoles in all animal cells lends strong support to the view of Guilliermond, Mangenot, Bensley, and others, that the plant cell vacuole is the homologue of the animal Golgi apparatus.

The above view of Parat also lends very strong support to the opinion that fatty yolk may arise from the Golgi elements. In spiders (Nath, unpublished), in Scolopendra (Nath and Hussain, unpublished), and in the firefly Luciola (Nath and Metha, unpublished), the juxta-nuclear Golgi apparatus consists, in Mann-Kopsch preparations, of rings which may also be appropriately described as vacuoles with a sharp chromophilic rim and a central chromophobic area. With the growth of the eggs, the Golgi rings proliferate and swell up and give rise to fatty yolk spheres by the

deposition inside them of free unsaturated fat which is stained black even by the osmic acid in Flemming-without-acetic. The most interesting point, however, is that when these osmicated fatty yolk spheres which appear solid are treated with turpentine, they show a chromophilic rim and a chromophobic central substance, exactly like the Golgi elements. On further decolorisation the yolk spheres appear like clear vacuoles, which give a frothy appearance to the whole egg.

Recently Miss S. D King (*Proc. Roy. Soc.*, June 1926) has given convincing arguments in favour of the Golgi origin of fatty yolk in the eggs of Oniscus exactly as in the eggs of Lithobius. It seems to me that there is no justification for the attacks that have been made on the above view of Gatenby and his pupils. My line of argument is perfectly simple. Golgi rings look like vacuoles, and fat spheres are certainly vacuolar in nature. It seems clear that the vacuole-like Golgi elements give rise to vacuole-like fatty yolk spheres, by a process of deposition in their interior of free fat not miscible with the general cytoplasm.

VISHWA NATH.

Bhupendra Research Laboratory,
Mohindra College,
Patiala, India,
October 7.

Anthropology and Administration.

ALL anthropologists will feel grateful to Mr. Ormsby-Gore, as well as to NATURE, for the vigorous pleading on behalf of the Imperial importance of our science by the Under Secretary of State for the Colonies, and for the interesting leading articles in the issues of October 30 and November 6. The passage from the Under Secretary's report quoted in NATURE is of special value for the right appreciation of anthropological methods. Mr. Ormsby-Gore sees clearly that " personal contact " is not enough. A " scientific study of their [the natives'] mental and moral characteristics, of native law and customs, of native history, language, and tradition " is indispensable. As is pointed out in the leading article, " There is now a wealth of accumulated experience and knowledge at our command in our schools of anthropology." I should like to add a few concrete suggestions as to how anthropology should be studied in order to be of direct use to the administrator.

The official in a Crown Colony has to legislate and to administer justice to his subjects ; he has to regulate relations between white settler and native-relations which are predominantly of an economic or judicial nature—and he has to deal in various ways with local custom and belief. Three lines of anthropological approach are therefore of extreme importance to the future Colonial administrator : early economics, the psychology of native races, and, above all, the theory of primitive jurisprudence. Remarkably enough, two of these branches of learning, economics and jurisprudence, have been almost entirely neglected until recently. Text-books of anthropology, and even of social organisation, as well as most records of field-work, ignore them or deal with them inadequately or one-sidedly. Yet both primitive production and consumption of wealth, as well as the principles of justice and its administration, are fruitful subjects of observation in the field, as I have proved from my own experience and have shown in my published work. When trying to co-operate with the Colonial authorities in the utilisation of native labour, and the preservation of native culture, it seems of paramount importance to insist from the onset that our science can and will assist directly the authorities in what they need most.

There is, moreover, no practical difficulty in the way of such teaching in Great Britain, for it has been provided for by two or three universities, including that of London, where anthropology is taught in several of its colleges. At the London School of Economics a chair of ethnology has been in existence since 1913—and afterwards a readership in social anthropology—while later on the teaching of this subject was also established at University College and Bedford College. In the Department of Ethnology of the London School of Economics, under the direction of Prof. Seligman, the study of the early economic systems, the principle of native law and of savage mentality has been carried on for the last fifteen years. With field-workers of the measure of Prof. Seligman and Prof. Westermarck, with sociologists such as Prof. Hobhouse and Prof. Graham Wallas, with jurisprudents specially interested in anthropology such as Prof. Jenks, the teaching of our science has gone hand in hand with that of comparative law, comparative sociology, and economic history.

Recently also chairs of international relations and international history have been set up at the London School of Economics, and are held by Prof. Baker and Prof. Arnold Toynbee respectively. A wide scope is given to the study of the subject, and problems of inter-racial relations ; the mutual influences of western and oriental culture ; and the diffusion of European civilisation among simpler peoples fall within the sphere of these two chairs.

To such studies the background of appropriate anthropological theory is indispensable. The anthropologist is able first to supply the dispassionate attitude of mind so necessary to the discussion of inter-racial problems. His methods, especially if he is trained in field-work, tend to develop that sympathy with each specific culture based on understanding, which is perhaps the best antidote to political bias or false sentimentalism.

At the University of London we have also perhaps the biggest school of comparative linguistics extant, the School of Oriental Studies. I believe that any serious attempt to train future settlers and officials in the anthropological outlook must include linguistic teaching both of a theoretical and practical nature. It is to be hoped that the already existing co-operation between the London School of Economics and University College will soon be extended, also the School of Oriental Studies, and that with the assistance and advice of the Colonial Office, some such scheme of training will be devised as that already in force in the universities of Holland, above all at Leyden. This scheme has proved invaluable to the Dutch Colonial authorities.

There is, then, a definite field for anthropological research which can be made practically useful to the Colonial authorities. By cultivating it more intensively than is done at present, anthropology can also be brought in touch with realities and be able empirically to verify some of its theories.

Nothing is so salutary to a new science as a pragmatic contact with facts. Without in any way swerving from the pursuit of purely theoretical ends, anthropology needs at present to be deflected from the curio-hunting sensation-mongering interest which had been its curse in the past. There is a useful as well as a useless anthropology.

B. MALINOWSKI.

Department of Ethnology,
London School of Economics,
University of London.

The Recurrence of Magnetic Storms.

A FEW remarks seem expedient on Dr. Deslandres' letter in NATURE of October 30. Various recurrence phenomena, including pulsations with periods of a few seconds or minutes, have attracted the attention of magneticians, but my original letter referred only to the recurrence of magnetic storms, that is, large disturbances of considerable duration experienced simultaneously all over the earth. The various members of a recurring series of storms do not seem to bear any special family resemblance to one another. The methods I have employed have demonstrated recurrence after intervals of 27 days or multiples thereof, but not in shorter intervals. I am uncertain whether Dr. Deslandres agrees that these large prolonged disturbances show only the 27-day interval T, or whether he believes that they also tend to recur to a lesser extent in intervals $iT/6$, where i is integral, and that the failure to show these shorter intervals is the fault either of my data or of my methods. He refers to doubts entertained respecting the international character figures. So far as I am aware, the only criticism passed on these is that any particular character figure, for example, 1·5, is not an absolute measure of disturbance, but may signify different amounts of disturbance in quiet and disturbed years. This criticism is one I have made myself, but the defect does not prejudice the use of the figures for discriminating between disturbance on consecutive days, the only purpose for which the figures have been used in the present connexion.

Dr. Deslandres also seems to suggest that the use of mean data from a number of years may obscure real recurrence intervals prominent in individual years. If, however, mean data from a number of years reduce to insignificance a period prominent in one or two years, it implies a remarkable deficiency of recurrences with this period in the other years, a phenomenon difficult to explain unless the prominence during the one or two years was a matter of pure chance.

As a matter of fact, the results which I gave from the international character figures did not represent an 11-year period, as Dr. Deslandres seems to suppose. Two separate periods, one of six years, 1906 to 1911, and one of five years, 1920 to 1924, were dealt with separately, and neither showed the intervals $iT/6$. The 11-year period 1890 to 1900 which I dealt with preceded the existence of international figures. The results for it were based on Kew data alone, the criterion of disturbance being the absolute daily range of the horizontal force. No trace of a period a submultiple of T appeared in that case either.

As regards the suggestions which Dr. Deslandres has made for the better utilisation of the international character figures, the employment of 14 instead of 5 selected days a month has two rather obvious drawbacks. It entails nearly three times as much arithmetic, and it largely waters down the amplitude of the primary pulse. There is admittedly no special virtue in the number 5; it merely happens to be the number of quiet or disturbed days internationally selected for each month. But long experience has shown that in disturbed months it is difficult to secure more than 5 reasonably quiet days, while in quiet months it is sometimes difficult to get so many as 5 reasonably disturbed days. The suggestion to consider individual cases individually embodies the procedure which I originally followed after Mr. Maunder's investigations directed my attention to the subject. When following this procedure I did not succeed in arriving at any conclusions from which I felt assured that the influence of personal bias had been excluded. For ascertaining definitely the cause of the phenomenon the consideration of individual cases may be essential. It has of course special attractions for astronomers like Dr. Deslandres or the late Rev. A. L. Cortie, S.J., who have corresponding solar data immediately available.

C. CHREE.

75 Church Road, Richmond, Surrey.

THE letter on the above subject by Dr. Deslandres in NATURE of October 30, contains a reference to some preliminary investigations made by me some fourteen years ago.

From Dr. Deslandres' remarks I gather that he regrets that I should have confined myself in these investigations to 10 spots, and I wish to correct this impression, inasmuch as I have subjected all spots which appeared during the years 1912–14, that is, three years, to the identical examination, but the space available permitted only of the publication of one specimen table. The result in all the many other tabulations was the same, but when the material I worked upon gave out, I certainly came to a standstill. However, by an odd coincidence, on the very day I read Dr. Deslandres' communication, I received a letter from Stonyhurst offering to provide me with all the required data on similar lines as those the *Observatory* used to provide so very suitably. Therefore I intend to take the matter up again, and desire at this juncture already to express my thanks to both Dr. Deslandres and the Stonyhurst Observatory officials for their kind encouragement.

I wish to add that I am equally delighted to read that Dr. Deslandres has also found the presence of the D_3 helium-line over merely faculic areas, an observational fact of many years' standing with me, and to which I have often referred in lectures and papers.

ALBERT ALFRED BUSS.

22 Egerton Road, Chorlton-cum-Hardy,
near Manchester,
November 8.

Post-Cretaceous Igneous Activity in Western India.

THE discovery of nepheline-syenite and monchiquite in Girnar, Kathiawar, announced by Dr. J. W. Evans in 1901 has, after a lapse of a quarter of a century, been followed by detailed petrographical and field investigations published in recent issues of the *Records of the Geological Survey of India* and the *Journal of Geology* respectively. The central mountain forms a dome of plutonic rocks intruded into the overlying Trap. Further investigations in Gujrat and Kathiawar have revealed a fascinating chapter in the history of post-Cretaceous igneous activity in India which is not dissimilar from the Tertiary igneous activity of Scotland. They acquire a special interest in view of the recent theory of magmatic cycles and its application by Dr. G. W. Tyrrell to the British Isles.

The plateau basalt which was presumably erupted from long fissures is, as a rule, free from evidence of explosive activity and the mode of its extravasation needs no description. This was followed in India by laccolithic intrusions, of which the Girnar and Barda hills are better known than others. A large circular dyke, corresponding to the ring-dykes of the Scottish intrusions, occurs round the central intrusion of Girnar (*Journal of Geology*, Vol. 34, No. 4). The long dykes which follow an approximately elliptical course east of Girnar and are so conspicuous in the Gir Range and near Gondal are, likewise, to be explained as

a result of the stresses set up by a concealed intrusion which denudation has not yet exposed to the surface.

In addition to these, a number of other laccolithic intrusions appear to lie on a line which runs from Baroda *via* Bhavangar and Girnar to the Barda hills. An assumed northerly shift of this line makes it continuous along the intrusions of Cutch, Baluchistan, and Persia. It indicates a zone of weakness which keeps its parallelism to the coast and along which the basaltic magma was still able to intrude itself when the ascensive force was unable to bring it any longer to the surface. Slow crystallisation at some depth in the local magma reservoirs brought about differentiation and resulted in the production of acid types which took a plutonic, hypabyssal, or volcanic phase according to the mechanical strength of the intruded beds and the movement of the magma. The acid igneous rocks of the Deccan Trap, therefore, appear to represent the end product of differentiation in a basaltic magma.

This period of laccolithic and dyke intrusions was followed by the manifestation of local volcanic activity of the explosive type at various centres probably on the top of cooling reservoirs. Detailed investigations have been carried out by us on the Pawagadh hill, near Baroda, the rhyolites of which were first described, after a hurried visit to this locality, by Dr. L. L. Fermor, who had suspected an interbedding of rhyolite with basalt. The results of our examination of the hill show that Pawagadh became a centre of volcanic activity of an explosive type long after the cessation of the eruption of plateau basalt, during which interval valleys had been carved out in the existing lava flows. Doleritic olivine-basalt was extravasated in contrast to the olivine-free compact plateau basalt, followed by andesitic lavas and tuffs. Rhyolite flowed at the end from a central neck at the top of the hill (2811 feet) and from a few other subsidiary vents at a lower level. The Osham hill, where the rhyolite occurs again as the end product, appears to have had a similar history. A number of other volcanic vents are known on the line of laccoliths indicated above. This association confirms the explanation of volcanic activity of the explosive type put forward by Dr. A. L. Day and supported by Prof. A. Holmes (NATURE, vol. 117, p. 66).

The above outline serves to indicate the fact that in Gujrat, Kathiawar and Cutch we have an interesting record of events of an igneous cycle initiated by a fissure eruption. Field and laboratory work is in progress which will throw light on the detailed history of this period.

K. K. MATHUR.
V. S. DUBEY.

Department of Geology,
Hindu University, Benares,
September 23.

The State and Industrial Research Associations.

THE arguments adduced by Mr. J. W. Williamson in his paper on "The State and Industrial Research Associations," published in NATURE of Nov. 6, have made out several good reasons for the permanent subvention of such bodies by the State. No doubt his arguments might be met by the counter-argument that each industry should and could take out its own policy of insurance against ignorance.

Between these two alternatives there is a middle course which suggested itself to me in the course of past experience connected with the actual founding of one such association. This course would, I think, meet Mr. Williamson's views, and yet would still leave the responsibility for profitable development to be carried by the industry itself.

The suggestion I would make is cognate with my analysis of research into eight classes, defined by the restriction or freedom of their methods, aims, and subjects respectively (NATURE, Aug. 28, 1926). In the second of these classes the research is restricted to a subject which may be of industrial importance, such as cotton, but it is otherwise free; not bound to any particular technique or science, not constrained to any aim, but working simply to increase the total of scientific knowledge concerning its subject, whether such knowledge be 'useless' or otherwise. Such research is a fit and proper subject for State endowment to a limited extent; indeed, it could probably make out a more forcible claim on social grounds than could pure science, my unrestricted first class.

In the organisation of such a research association as already exists, the endowment would support a nucleus organisation within it, whereto some three members of the staff would be allocated in such a way that even if an industry decided to abandon its association, the nucleus thereof would still continue to exist and function, upon a laboratory footing. Laboratories are not costly if they have not to concern themselves with the application of results; the administrative charges of such a nucleus would be trivial; the staff would, by definition, be picked men who could co-operate as colleagues without other formal direction than that of the accidental senior amongst them. They could be housed in some existing institution until such time as their industry saw fit to re-crystallise its research around this nucleus, in order to make their results usable by further studies made under restrictions of aim or method.

A State endowment of less than 4000*l.* a year would ensure such a nucleus of permanent appointments—not permanent staff—for each industry, and this nucleus would cost the same amount for every industry, large or small. The staff of an existing association would then be assured that, even if their association dissolved, still the roots of their work would continue to grow forward. Issues too big to be profitable could be taken up by this nucleus staff; issues too profitable to be interesting would be willingly met by temporary expansion of the industry's direct contribution, and the subsequent contraction would not involve a risk of disintegrating the whole structure.

A certain insecurity which is inherent in any organisation built entirely on voluntary levies has an unfavourable influence on research, and while I do not quite agree with Mr. Williamson's cogent plea for a permanent State support of research associations as at present constructed, I believe that the insertion therein of such permanent nuclei would sufficiently ensure all the aims he has expressed, and more.

W. LAWRENCE BALLS.

Meldreth, Royston,
Herts., November 10.

Modern Photometry.

ALTHOUGH, as the reviewer of Mr. J. W. T. Walsh's "Photometry" in NATURE of October 23 says "The reader must not object to change" and "This is not the place to discuss fully the vexed question of nomenclature," and that "of course" Mr. Walsh uses the terminology adopted by the International Commission, I join in regretting the exchange of 'candle-power' for the words 'luminous intensity.' The official language of the Commission is French. Of course, 'candle-power' cannot be literally translated into French. I pointed out, at the meeting of the Commission in 1921, that M. Blondel at the Geneva Congress in 1896 had used the expression '*puissance lumineuse*,' but it was objected that the word *puissance*

cannot now be employed in that sense. In English usage, 'candle-power' is strictly a form of power, and might, if we had the data, be defined in ergs per second. In French, an electric current cannot be strictly expressed in amperes, but the *intensité* of a current can be so stated. In English, the notion of *intensité* is here redundant, and, as the reviewer observes, "In scientific English the word 'intensity' always connotes something analogous to 'energy per unit area.'"

A good deal might be said about the proper use of the term 'flux,' when 'luminous flux' is to be substituted for 'light.' Flux is generally employed in English to connote a flow, not a rate. 'Luminous radiation' is all that is wanted, without introducing the conception of a rate. Need we stop to consider, or wait to know what light is before using the word in scientific English? Heat is not easy to define, temperature is less easy, but no new terms are wanted here.

A. P. TROTTER.

Teffont, Salisbury,
October 30.

I AM very glad to find Mr. Trotter in agreement with me regarding some points in photometric nomenclature, but in reply to his concluding remarks I have only to suggest that the scientific use of the term 'light' should be at least as exact and simple as its ordinary use in English. Terms like 'ultra-violet light' are simply ridiculous. That is why I suggested a greater care in the use of the word. Why manufacture new terms because a very small proportion of the population misuses the good old words?

L. C. M.

Broadcasting Birth-control.

SIR JAMES MARCHANT, in a letter published in the *Times* of November 17, refers to my "extreme and one-sided views" on the subject of birth-control. As there appears to be much misconception in regard to what I actually did say on this subject during the broadcast debate on "Is Science Bad for the World?" on November 16, I should like to have the opportunity of putting my words on record. They were as follows:

"Birth-control is capable of great harm, if it is not regulated; but its absence would lead to greater harm. It therefore must be regulated and supervised by the State" (or, I would now add, by the medical profession), "and the nation should allow no interference on the part of prudery or of religious intolerance. . . ." Here I was interrupted.

I claim that this statement was neither extreme nor one-sided. Whether subjects like 'birth-control' should ever be mentioned on the wireless is another issue altogether. To me personally, letters such as that of Sir James Marchant appear to add point to the fear which has been expressed that State control of broadcasting might well tend to dulness and sterility through a banning of all controversial matters. Had broadcasting been possible in 1859, doubtless no expression of opinion would have been allowed over the wireless on the shocking question of whether man had not been specially created, but had evolved from animals.

However, I am here only concerned to defend myself from the imputation of having abused my privileged position at the microphone. I should also add that a year ago I was invited to give a series of wireless talks on biology and human life, and that no objection was then raised by the B.B.C. to the brief references to birth-control which I there made. I therefore conclude (and earnestly hope that I am correct) that though the policy of the B.B.C. may be against the raising of the question in a controversial way in debate, this does not preclude the topic from ever being mentioned over the wireless.

JULIAN S. HUXLEY.

King's College,
Strand, London, W C 2.

Spectrographic Junction between the X-ray Region and the Extreme Ultra-violet.

IN a letter published in NATURE of October 16, p. 551, Dr. A. Dauvillier has announced some preliminary results of attempts to get spectroscopic evidence of the unknown region between the X-rays and the extreme ultra-violet. He has followed the same general methods and technique as have been used by me in measuring the K- and L-series of the formerly unknown domain of wave-lengths 12 Å.U.-25 Å.U. (*Phil. Mag.*, February 1926).

My experience from this work is that a thorough critical scrutiny of the obtained spectrograms is necessary to exclude erroneous interpretations. To show that the lines found were not ordinary short wave-lengths reflected in higher orders or in other atomic planes than those supposed, Dr. Dauvillier has used goldbeater's foil. Our experience is that such foils, even of the thinnest obtainable sort, absorb completely all wave-lengths greater than 13 Å.U.-15 Å.U., and therefore it is scarcely possible by this means to identify the longer wave-lengths.

It is also surprising that a foil of magnesium thick enough to prevent the photographic plate from fogging by the rather intense ordinary light would transmit this very soft radiation in any considerable amount, especially when the relatively small intensity of the N- and O-series, as also theoretically suggested by Kramers, is taken into account.

It will, however, be of great interest to get a detailed report of these experiments, which, if they prove to be correctly interpreted, are of high scientific value.

ROBERT THORÆUS.

Physical Laboratory of the University,
Upsala, Sweden, October 29.

Quantum Theory and Intensity Distribution in Continuous Spectra.

THE undulatory mechanics makes it possible to give a quantum theory of aperiodic phenomena, and, in particular, to compute the intensity distribution for continuous spectra. The theory has recently been applied to the hyperbolic orbits of the hydrogen atom (*Proc. Camb. Phil. Soc.*, Oct. 1926). The results are too complicated to be given here in detail; but they yield an estimate of the intensity distribution in the continuous X-ray absorption spectra. This is, I believe, the first experimental verification of this part of the theory.

According to the theory, absorption sets in discontinuously at the series limit with a finite value, which, for a given n_k electron, is proportional to the wave-length of the limit. For very short waves the absorption coefficient is of the form $f(n,k)Z^{2k+2}\lambda^{2+k}$, where Z is the effective nuclear charge and λ the wave-length of the radiation, and where $k = \frac{1}{2}, \frac{3}{2}$ . . . . The values of $f(n, k)$ give atomic absorption coefficients $Z^{\alpha}\lambda^{\beta}$, where α ranges from 3 to 4·5, and where β, for the shortest waves, is 2·5, and for the customary range varies between 2·5 and 3. This is in agreement with the empirical formulæ.

J. R. OPPENHEIMER.

Institut für Theoretische Physik,
Göttingen, October 30.

University Laboratories and Research.[1]

By Sir J. J. THOMSON, O.M., F.R.S.

PHYSICAL laboratories at the present day are very different from those existing when I began to study physics now, alas, more than fifty years ago. In those days they could be counted on the fingers of one hand. They were not palatial buildings, but for the most part consisted of a few odd rooms, wrung from a reluctant governing body by the importunity of the professor. The physical laboratory of Owens College, now the University of Manchester, where I began my study of physics, was a few rooms which nobody else wanted in Cobden's house in Quay Street, and I believe that one of the rooms in Lord Kelvin's laboratory at Glasgow was an old coal-cellar. The whole equipment of apparatus could in many cases not have cost more than a few hundred pounds. Now almost every university and technical school has a separate building equipped with expensive apparatus.

The provision of these laboratories, and the funds required for their maintenance, has become a very serious question for those responsible for the finances of our universities. I am afraid that physical laboratories are especially expensive. I am afraid, too, that the sums required for their equipment and maintenance are much more likely to increase than to diminish. They have indeed increased very rapidly of late years. Let me give an example of my own experience. At the beginning of this century there were about thirty persons doing original work at the Cavendish Laboratory. Their researches cost the laboratory between 300*l.* and 400*l.* a year. The cost now would be at least six times that amount. As science progresses the instruments required become more and more elaborate and expensive. The old endowments of the universities and the fees from students are quite inadequate to meet the expenses on the new scale. New studies require new endowments; there is still need, nay, there is increasing need, for the 'pious founder.'

It would be ungrateful, however, not to acknowledge the liberal help which is now given to physical science by the Government of the country, partly by grants to the universities, partly by grants for research administered by the Royal Society, and partly by the formation of the Advisory Council for Scientific and Industrial Research, which, among other things, finances the National Physical Laboratory. The Government, indeed, is now giving to physical science far more than any Government gave before. To the liberality of some of the city companies we owe some fine laboratories, and there are many private benefactors to whom our gratitude is due, but there is still room, nay, need, for many more.

It is not necessary for me to dwell on the educational value of the study of science in our universities and schools. Indeed, there are those who maintain that it is the literary studies that are in danger of neglect. I believe, however, that the vast majority of scientific men recognise the great, nay, the vital importance of literary subjects in education, and would view with horror a system from which they were absent. Both are necessary, but in my opinion science without literature would be worse than the old system of literature without science.

The educational value of the training in science depends to a great extent upon work in the laboratory. What are the educational values of science? Are they not that science arouses and does something to satisfy the wonder and curiosity we feel about the marvellous processes going on in the world around us; that it cultivates and develops the powers of observation; that, and this is a most important point, it teaches us to reason about facts that come under our own notice? It gives the student confidence in the powers of reason. I think every teacher of science knows that when a student calculates from the principles he has been taught what will happen, say, when light passes through a system of lenses, and on proceeding to try the experiment finds that the result agrees with his predictions, it comes to him as a great surprise. It comes almost as a shock that human reason can lead to accurate results. Nothing helps a student to use his reason more than the belief that it can be trusted. But to get these educational values from science the laboratory is essential; it is there that the facts on which he has to exert his reason are to be found, where the contact between the facts and the intellectual effort takes place. Again, by his experiments the properties of light, electricity, and so on are impressed upon his mind with a vividness possible in no other way. It is in the laboratory that we realise that close touch with Nature which is essential to the progress of science.

It is the duty of the universities to enlarge the bounds of knowledge, as well as to instruct the community in the knowledge already won. Such research is of great value to the community The discoveries made in the universities by people working simply to increase human knowledge, without any idea whatever of any industrial application, are the very discoveries which create new industries and revolutionise the old. Take the case of the electrical industry. How did that come into existence? It was not because somebody set to work to develop a method for the transmission of power. It arose because Faraday wanted to try, in the laboratory at the Royal Institution in London, what would happen if he moved a magnet about near a coil of wire. That industry would never have been created if he had simply worked with the idea of discovering something to transmit power. I want to emphasise this point because there are many who say that the only legitimate object of research to which public funds should be applied is research with definite industrial intention. I am the last to decry *ad hoc* research, but it is not enough.

When bows and arrows were the most formidable weapons, it would have been a very good thing to establish a Bow-and-Arrow Research Association to make sure that one had got the best bow and arrow possible. But some man, working to get knowledge for its own sake, discovered gunpowder, and made the best bow and arrow obsolete. The truth is that Nature is so full of wonderful things that there is probably a much better solution of any problem than any we possess. We shall not find it by working directly on the problem, but if we work away, faithfully recording

[1] From an address delivered at the opening of the new science laboratories at the University College of North Wales, Bangor, on November 2.

what we see in our experiments, we shall probably get a hint and arrive at results which may be of importance. It is difficult to say that any discovery which is made is devoid of commercial value. Our experience in the War showed us that the most recondite phenomena, known only to a few, could be applied for the service of the country.

I have heard the fear expressed that the multiplication of laboratories may lead to something like over-production—that there may not be enough discoveries to go round. Such a fear seems ludicrous to a physicist who knows that a discovery is not a terminus but an avenue opening up new and wider fields for work. We are surrounded on all sides by physical and chemical phenomena of which our knowledge is not even in its infancy, scarcely in embryo. Consider for example the chemical and physical properties of living matter. A tiny seed is put into the ground and becomes with nothing but the soil, water, air, and light a workshop weaving for leaf, flower, and fruit fabrics of exquisite texture, moulding these with unerring accuracy into shapes of the greatest variety and complexity, dyeing them all the colours of rainbow, often spreading the colours in patterns full of minute and elaborate detail, laying up stores of substances, most of which are beyond the power of the chemist to produce, and finally producing other seeds able to produce the same effects. Compared with results like this our workshops, our looms, our dye-works seem clumsy and inefficient. What is the mechanism by which these wonderful results are produced? We have no idea.

To find out the mechanism of this tiny seed we shall have to develop methods of investigating the changes that go on, almost molecule by molecule. Of late years methods have been devised which are continually diminishing the distance between us and the solution of these problems, and in the not too indefinite future we may hope to get to know something of the way in which those marvels are accomplished. This requires the co-operation of many sciences, and it seems to me that the new buildings at Bangor are admirably fitted to take part in this great work.

Richard of Wallingford and his Rectangulus.

By Dr. R. T. GUNTHER.

THE celebration of the sixth centenary of the elevation of Richard of Wallingford to the Abbacy of St. Albans in 1326 is an occasion of far more than local interest, for it is also the celebration of the sixth centenary of the beginning of trigonometry in England.

Richard's father was a blacksmith in the village of Wallingford, who died when the son was only ten years of age, but Richard was fortunate enough to be adopted by the Prior of Wallingford, who sent him to Oxford at the age of seventeen. Six years later he was admitted to the monastery of St. Albans, perhaps, as Sir Edgar Wigram has suggested, because he instinctively recognised that in those days a monastery was the only refuge where a man of science could find license and leisure to prosecute his studies undisturbed. But after three years training, Abbot Hugh sent him back to Oxford as one of the students whom every Benedictine house was bound by statute to maintain at the University, in order to ensure that its learning should be kept up to standard. Apparently to the deep concern of the chronicler, Richard then proceeded to spend valuable time on mathematics and astronomy, which he was expected to devote to theology. But in 1326 he had his reward by being elected Abbot of St. Albans, and, as after events proved, turned his scientific training to good purpose by reducing the debt and by rebuilding the Cloister of his Abbey.

We have two miniature portraits of Richard of Wallingford in the illuminated chronicle of Matthew Paris. In the first he is engaged at his bench making or measuring a circular instrument with a pair of compasses. His simple tools are lying by his side and his Abbot's mitre is on the floor. In the second portrait he is pointing to the famous clock which he made for the Abbey. A point of singular interest is the fact that in both portraits he is represented with a spotty face, indicating the ravages of the incurable disease of leprosy which he had contracted at Avignon. Indeed, of this we have confirmatory evidence in a prayer composed by him in later life after his promotion as Abbot. The words are worth quoting, if only as an example of the devotions of an English man of science of the fourteenth century.

> Though I be a man of lowly state, and smitten by Thy providence with an evil plague, so that I am not worthy to walk among men, but should by law be cast without the camp; yet Thou, O Lord my God, by what secret judgement I know not, dost yet hold me in honour, such honour as I have known none of my parents or kindred to attain to, in all health of body; and as I oft-times remember with wonder at Thy great bounty, dost so incline the hearts of the great towards me, that ever when present, they d not abhor my speech and the deformity of my face and hands, but rejoice to converse with me. . . .

We may, therefore, claim that the miniatures are truthful representations of "The Father of Trigonometry" in England.

Wallingford's trigonometrical methods are indicated in two works, *De sinubus demonstratis* and *De sinubus et arcubus in circulo inveniendis*, and their practical application is further described in his treatise on the Art of working with a Rectangulus.

Two scientific treatises on the 'Albion' and the Rectangulus are dated about the time of his election as Abbot. Fortunately, illustrated copies of the manuscript are still extant and they include many working drawings which reveal the construction of the instruments so clearly that a reconstruction is possible.

The 'Albion' has often been stated to have been the Abbey clock for which he is famous; but the evidence of the original manuscript points to its having been an elaborate Aequatorium or Volvelle composed of a number of circular dials for showing the position of the planets: the name 'Albion,' or all-by-one, having reference to the various operations which could be performed by the one instrument. There is no mention of cogwheels, pulleys, and weights, or of any driving

or regulating apparatus in [illegible] xion with the Albion. Doubtless it was intended to [illegible] used with his other invention, the Rectangulus, with which the relative positions of stars could be measured.

In the prefatory sentences to his treatise on this instrument, Richard tells us that he invented the Rectangulus in order to obviate the laborious and difficult use of the Armillary Sphere in determining the course and place of fixed stars and planets, and for other problems which were usually solved by the astrolabe and the torquetum. The fundamental principle of the instrument is based on the theorem of Euclid on the equality of the angles and lengths of equidistant lines between parallels.

The instrument consists of three superposed limbs or rules connected by hinges in such a manner that each limb may not only be opened out at varying angles like the blade of a pocket knife, but may also be rotated round a peg-pivot below its hinge. Above all is an alidade, or rule with perforated sight-vanes, which is so hinged to the third limb that it can be either elevated above it or be moved parallel with it. The hinges may all be clamped more or less tightly by wedges driven through slots in the pegs, like those used in astrolabes.

To complete the instrument six scales of bronze were prepared and graduated. Three of these are fixed to the sides of the three limbs; the other three are movable, being pivoted on the pegs under the limbs. The lowest scale was divided along the edges into 60 equal divisions called degrees or parts of chords, *gradus seu partes cordarum*, each of which might, in the case of a large instrument, be further subdivided into 60 parts, while the middle or intervening band was divided by a table of right and versed chords, *corde recte et verse*. This middle divided band is omitted in the five other scales. The division of the upper scale of chords, which are called right chords, are numbered from the peg to the end of the scale; the lower scale, called versed chord, is numbered from the end of the rule to the peg. The ends of the alidade and upper limbs are provided with plumb-lines.

In his second treatise on the use of the Rectangulus, Wallingford explains in ten chapters how various observations and calculations are to be made. In the first place the whole instrument must be adjusted for level by a plumb-line fixed near the surface of the base pillar. The instrument is then ready for the first exercise, "To find the right and versed chord of a given arc less than a quarter of a ci[illegible] to find any arc from a given chord." The [illegible] in his ov[illegible] words, as translated by Sir John Fin[illegible] is to

let the perpendicular of the second limb hang over the first limb at the given arc, the length between the peg and the string reckoned from the peg to the end of the limb is the right chord of the arc. The distance beyond the string, reckoning from the point of the limb, gives the versed chord of the same arc. The reverse process enables an arc to be found from its chord. Note that the plumb-line hangs at right angles when it falls on equal divisions of the scales on both sides of the limb, and this is chiefly why the scales of chords are double on all the scales. The right and versed sine of an arc greater than a quarter of a circle may be easily found from what has been said, for the right sine of an arc less than a quarter of a circle is the right sine of the arc of the rest of the circle. Further, the versed sine of an arc greater than the quarter of a circle but less than a semicircle is greater than the semidiameter by the amount of the right chord of the angle by which the given arc is greater than a quarter of a circle, as is shown elsewhere.

Then follow chapters upon how "To find the meridian," "To find the altitude of a star above the horizon and its azimuth," "To find the latitude of a place by a star which does not set," "To find the latitude and longitude of a star from the equinoctial circle," "The declination of a star and its latitude in the ecliptic," "To find the true place of the sun from its aspect," "To find the true place of the moon in longitude and latitude," "The true place of fixed stars in latitude and longitude."

The treatise concludes with the sentence, "The Rectangulus was invented for the purposes which have been explained, and therefore, because what has been explained is sufficient for an apt pupil, the way is clear to everything that can be done by other instruments. Here I finish."

Wallingford died in 1335 at the age of forty-three. It is reported that the Abbot's house where he was sleeping was struck by lightning, and, weakened as he was by his disease, he did not survive the shock. His tomb is in the Abbey Sanctuary just east of the altar rails.

A Remarkable Suborder of Fishes.

DURING the Danish *Dana* Expeditions of 1920–1922 in the North Atlantic and the Gulf of Panama, under the leadership of Prof. Johs. Schmidt, a magnificent collection of ceratioid fishes was made, which forms the subject of a monograph by Mr. C. Tate Regan,[1] Keeper of Zoology in the British Museum (Natural History), from which the accompanying illustrations have been reproduced. Prior to the *Dana* Expeditions, and excluding the *Michael Sars* collection, as yet undescribed, only about sixty examples of this amazing suborder of fishes were known, so that the *Dana* addition of 220 specimens representing 39 species, many of which were new to science, was of great biological value.

The Ceratioidea form part of the order Pediculata, that group of highly specialised fishes in which the first ray (illicium) of the spinous dorsal fin is placed on the head and modified into a 'line and bait.' Their characteristic features are evidently related to their conditions of life. They are inhabitants of the deeper parts of the ocean, the majority living in mid-water, probably from 500 to 1500 metres below the surface, where there is little or no light. Related to the absence of light is the structure of the 'bait,' or terminal expansion of the illicium, which is a luminous bulb; the outer skin of the bulb is generally transparent, and within is a glandular sac that opens to the exterior by a pore and has a luminous secretion; the lower, or

[1] "The Pediculate Fishes of the Suborder Ceratioidea." By C. Tate Regan. The Danish *Dana* Expeditions 1920–1922 in the North Atlantic and the Gulf of Panama. Oceanographical Reports edited by the *Dana* Committee, No. 2 (Copenhagen, Gyldendalske Boghandel; London: Wheldon and Wesley, Ltd., 1926.) 15s.

sometimes the posterior part of the sac is pigmented, and this pigmented area, according to Brauer, is covered inside by a layer of cells which acts as a reflector. Externally the bulb may be furnished with papillæ, flaps or tentacle-like filaments. There are great differences in the length of the 'line' or first dorsal ray; from fishes in which the luminous bulb is sessile on the head, to those in which it is borne on a line several times as long as the fish itself. The line is articulated to the anterior end of a movable basal bone which as a rule lies in a trough on the upper side of the head. Those more highly specialised forms, in which the basal bone is slender and flexible and completely exserted, may be considered true anglers, for they have both rod and line, and Lasiognathus (Fig. 1), which is in addition provided with hooks, may well be termed a complete angler.

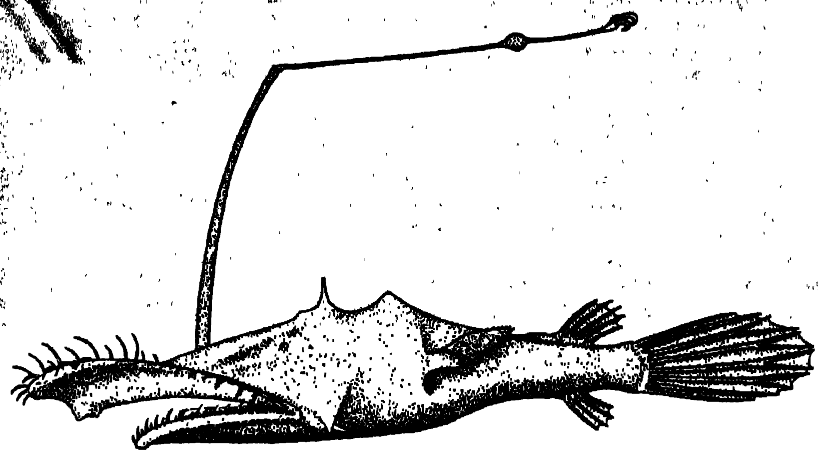


FIG. 1.—Lateral view of *Lasiognathus saccostoma*, Regan. Length 75 mm.

The majority of the ceratioids appear to be piscivorous, and have a large mouth and jaws furnished with slender acute teeth which are generally arranged in about three series. The teeth are depressible inwards, an arrangement which would make it very difficult for a ceratioid to release a fish it had seized, even if it wanted to. Neoceratias (Fig. 2), with teeth on top of the head that recall the spines of an echinoid, is perhaps the strangest of all. In some genera the stomach is extraordinarily distensible; thus a Melanocetus has been known to swallow a Lampanyctus three times its own length and many times its weight. Equally remarkable are the pincer-like jaws of Rhynchoceratias, and the forwardly directed telescopic eyes of Aceratias, indicating that the fishes of this genus have binocular vision.

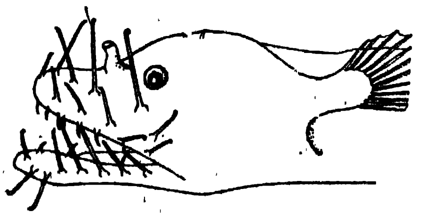


FIG. 2.—Head of *Neoceratias spinifer*, Pappenheim. Length to base of caudal fin, 25 mm. After Pappenheim, 1914.

Probably the chief interest in the ceratioids lies in the fact that they are unique among vertebrates in having the males dwarfed and parasitic on the females. The species in which males are known are *Photocorynus spiniceps* (male 10 mm. long attached to a female of 62 mm.), *Edriolychnus schmidti* (male 14 mm. long attached to a female of 62 mm.), and *Ceratias holboelli* (males of 80 and 85 mm. on a female of 1030 mm., and a male of 105 mm. on a female of 1000 mm.) (Fig. 3).

The males resemble the females in general form, but differ from them in the development of structures for attachment, in the absence of the illicium, the reduction or absence of spines on the head, the absence of teeth, and the vestigial condition of the gut; the only organ of importance in the abdominal cavity is the large testis. The method of attachment to the female is of especial interest. In Photocorynus and Ceratias, upper and lower outgrowths of the anterior end of the head of the male unite in front of the mouth and fuse with a papilla-like projection from the skin of the female.

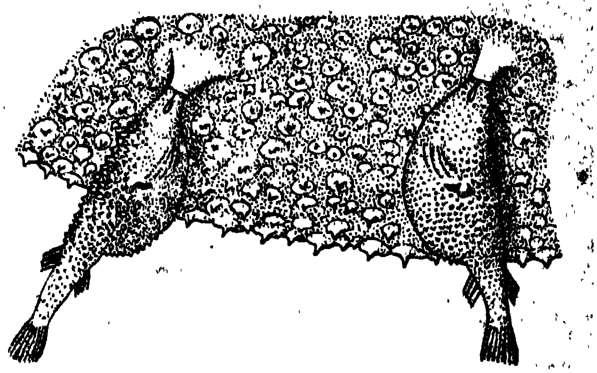


FIG. 3.—Two males of *Ceratias holboelli*. Half natural size. After Sæmundsson.

From his microscopic examination of sections of a strip of the tissue connecting the male and female Ceratias, Mr. Tate Regan is of the opinion that the male and female are completely blended, the highly vascular fibrous tissue of the outgrowths of the male being continuous with that of the papilla of the female, and he regards it as almost certain that the blood-systems of the two fishes are continuous. He does not favour the view that the attachment may be of the nature of a placenta, which implies that the two animals separate later on, but suggests that the males, soon after they are hatched, attach themselves to the females, if they are fortunate enough to meet them, and remain attached throughout life. In all probability the males are incapable of free development, and it is likely that the majority fail to find a female and perish, although another possibility has been suggested, namely, that the post-larval fishes that find and become attached to females develop into males, and those that do not, into females.

The Reform of the Calendar.

SINCE the War a number of ingenious schemes have been put forward for the reform of the calendar. Such an important step should not be taken unadvisedly, lightly, or wantonly, but the advantages claimed should be considered, the extent of the demand for it assessed, and the possibility of finding a scheme which would meet general approval carefully weighed. The League of Nations, being in a position to consult the various bodies which could give authoritative expression to opinion on the subject and the aid of which would be required in carrying out any changes proposed, undertook a full inquiry. It appointed a committee, with Prof. van Eysinga of Leyden as chairman, and with representatives of the Holy See, the Orthodox Church, the Church of England, the International Chamber of Commerce, and the International Astronomical Union upon it. This committee has recently issued a short and valuable report.[1]

The principal defect in the Gregorian Calendar arises from the unequal lengths of months, quarters, and half-years, which introduce a certain amount of irregularity in statistics, accounts, commercial and transport figures. This is increased somewhat because different days of the week are of unequal value as regards volume of trade, and thus one year or one quarter is not strictly comparable with another.

Minor defects are that special tables are required by banks in their calculations of interest, and that dates of periodical events, for example, the opening of Parliament, cannot be fixed without reference to a calendar. As many as 185 schemes of reform were received by the committee, including 33 from France, 27 from the United States, 24 from Germany, and 5 from Great Britain. The minimum change proposed was to take a day from August and give it to February. A second suggestion made the months of three of the quarters of the year consist of 30, 30, and 31 days respectively, and the last quarter of 30, 31, and 31 days. The question may well be asked whether the advantages are sufficient to justify the change.

A more radical reform is obtained by the use of one day without name in ordinary years and two such days in leap-years. The remaining days of the year may then be divided into 52 weeks, which may be arranged as four quarters of thirteen weeks, the months consisting of 30, 30, and 31 days, or as 13 months of 4 weeks each. The advantages and disadvantages of these two schemes are compared, and preference on the whole given to the former. The committee is satisfied, and most people will agree with it, that there is no general demand for these changes, which would be strongly opposed by many religious bodies. Without general assent, confusion would result, and it may be remembered that the Gregorian Calendar was introduced in 1582, adopted in Scotland in 1600, but not in England until 1751, and in eastern Europe only six years ago.

The committee next considers the question of fixing or 'stabilising' Easter. At present Easter Sunday varies between March 22 and April 25. This wide range makes difficulties in the arrangement of school and university terms and of public holidays. Many commercial transactions and transport services are prejudiced, in particular, business dealing with textiles, articles of fashion, and the hotel-keeping industry. There appears to be a consensus of opinion in these circles that the second Sunday in April would be the most convenient date. The committee favours a slightly different date, namely, the day following the second Saturday, in order to avoid the contingency of the festival of the Annunciation and Passion Sunday both falling on the same date.

The committee has made general inquiries of the attitude of the heads of different Christian Churches on the stabilisation of Easter. It is agreed that there is no dogmatic reason against a fixed date. It appears that the Church of England and the Greek Church are ready to accept the change if the Church of Rome also accepts it. The Holy See does not consider that there is sufficient reason for changing a date handed down by immemorial tradition and sanctioned by councils from early times, and would not be prepared to consider the question except on the advice of an Œcumenical Council. The Protestant Churches of Europe and America and the Jewish Community raise no objections to the proposal.

The report of the committee of the League of Nations shows that there is a general belief, certainly in England, that the stabilisation of Easter would bring substantial advantages and a wish to see the change made. As there are no difficulties of dogma involved, it may be hoped that ecclesiastical concurrence is not impossible. Incidentally, uniformity in keeping Easter will be secured between the different Churches. At the present time the Greek Church uses the position of the moon to determine Easter, while the tables of Clavius are still retained by the Roman and Anglican Churches. Sometimes the two methods give the same date; frequently they differ a week, and occasionally a month.

F. W. D.

[1] Publication of the League of Nations, viii. Transit, 1926, viii. 6. (London: Constable and Co.) 3s. 6d.

Obituary.

PROF. J. D. F. GILCHRIST.

PROF. J. D. F. GILCHRIST, who died recently in Capetown at the age of sixty years, had been in South Africa for thirty-one years. Gilchrist's early university days were spent at St. Andrews and Edinburgh. At one time he had thought of entering the Presbyterian ministry, but after coming under the influence of inspiring leaders in natural science at St. Andrews and Edinburgh, he definitely resolved to pursue a biological career. After a period at Münich and Zurich, and at biological stations, more especially that of St. Andrews, he was appointed, on the recommendation of the late Sir John Murray, of the *Challenger*, and of Prof. M'Intosh, St. Andrews, to the position of Government Marine Biologist at the Cape of Good Hope.

Gilchrist was probably the first to hold the title of Government Biologist in any country, and in his later days he was wont to tell his friends about the weary,

uphill task he had during his first year, in a government office in Parliament Street, Cape Town, without either laboratory or practical equipment of any kind. He was, however, able to persuade the Ministry of Agriculture that a vessel for dredging and trawling, a museum for storing the specimens, and a marine laboratory and aquarium were necessary.

Gilchrist was particularly fortunate in securing as the first captain of the government trawler, Alexander Turbyne, a keen fisherman naturalist, who had been trained under the late Sir John Murray. An important practical result of the preliminary surveys of the S.S. *Pieter Faure* was the discovery in 1898 of a rich fish-ground on the Agulhas Bank, within easy reach of the markets of Cape Town. This discovery appealed alike to the public and to the Government, and led to greater financial support.

While recognising the necessity of developing the economic aspect of marine biology, Gilchrist always kept the more purely scientific point of view in his mind. The Cape waters had only been explored in a cursory manner by such expeditions as the *Challenger* and the *Gazelle*, and thus there was open ground for more thorough investigations. The dredging and trawling expeditions of the *Pieter Faure* resulted in the capture of more than twenty thousand specimens, the majority of which, with the exception of the fishes, were despatched home to be studied by specialists. From the papers published by these workers, and from his own contributions, Gilchrist edited the volumes "Marine Investigations in South Africa" (1902–1907). In 1907, however, during a period of severe financial depression in the colony, the office of Government Biologist was abolished, but the publications were revived in 1913, under a new board, as "Marine Biological Reports of the Cape Province."

From 1905 to 1917, Gilchrist was professor of zoology in the South African College, and when, in 1918, the latter developed into the University of Cape Town, he held the chair of zoology until in 1925 ill-health compelled his retirement. After his resignation he still carried on some work at his favourite haunt, the St. James Marine Station, on the shores of Kalk Bay.

Gilchrist was the author of numerous papers, dealing more especially with the description of new or rare species of fish, and of their larval development; but he also contributed publications of more general interest, such as those on the early stages of *Cephalodiscus gilchristi*, on the enteropneust, *Xenopleura vivipara*, on the remarkable crawling medusa (*Cnidonema capensis*, g. et sp. n.), and on the temperature and currents of South African seas.

Sometimes Gilchrist may have conveyed the impression of a man who lived in a little world of his own, wrapped up in thoughts of his fishes and other denizens of the sea, but that he could free himself from these deliberations is proved by his work for science in the colony, as president of the Philosophical and later of the Royal Society of South Africa, and as one of the main organisers of the South African Association for the Advancement of Science.

Gilchrist married Elfreda Ruth, daughter of S. H. Raubenheimer, of George, C.C., and is survived by his widow, a son, and a daughter.

News and Views.

ONE of the problems to which the Imperial Conference has been devoting attention is the present position of forestry within the British Empire. A sub-committee was set up, which dealt with this matter on broad lines. It is a hopeful augury for the future that the question of a forest policy common to the Empire as a whole, with especial reference to the world's timber supplies, should have been examined in some detail. It is an accepted fact that the available virgin supplies of the soft woods (pines and firs) are giving out, Canada and north Russia and Siberia containing the chief remaining stocks. About eighty per cent. of the wood used for industrial purposes consists of the soft woods. As regards the hard woods, the available supplies of these from temperate climates are not regarded as satisfactory, and their replacement by tropical hard woods offers difficulties which are very far from solution. Apart from the question of the availability of the existing supplies to meet demands, there exist social and economic problems which make it necessary that each country, and perhaps more especially the British Empire, should formulate a policy which shall maintain a sufficient forest area under a conservative forest management. At the present day a large proportion of the Empire forests have little that can be termed a scientific conservative management in being; the Imperial Conference will have made a long step forward if, as a result of the deliberations and recommendations of the sub-committee, a consistent forest policy is formulated and adhered to. Other matters given consideration were Empire settlement and its connexion with forestry, the meeting of the Empire Forestry Conference in Australia and New Zealand in 1928, forest products research work, and the proposed inauguration of an Imperial Forestry Bureau.

THE silver medal of the Zoological Society of London has been awarded to Capt. H. C. Brocklehurst, the Game Warden of the Sudan, in recognition of his services to the Society, and for the active part which he has taken in the preservation of the wild fauna of that part of Africa. The medal, which was designed by Landseer, has been awarded on forty-eight previous occasions, the first recipient being Sir Roderick Murchison, in 1847, "for assisting in the introduction of the Aurochs." Capt. Brocklehurst has been instrumental in obtaining several valuable collections of animals for the London Zoo. The last of these included two giraffes, two Sudanese oryx, and three shoebills, or whaleheaded storks, now one of the rarest birds in the world. The white rhinoceros, which a little time ago was threatened with extinction, comes directly under Capt. Brocklehurst's care, and it is reassuring to hear from him that, owing to the proper administration of suitable game laws, this wonderful

animal, which sometimes exceeds 6 ft. at the shoulder, not only is out of danger of becoming extinct, but is even increasing so rapidly that a certain number are now allowed to be shot each year, and he has every hope of obtaining a young one for the Society's collection. From other parts of Africa the reports on game preservation are equally reassuring, especially from the Transvaal, where, after twenty-six years of political struggle, the Great Sabi Game Reserve has been established on a permanent basis, and has been given the name of the Kruger National Park. In relation to this it is highly satisfactory to note that Col. J. Stevenson Hamilton, who was chiefly responsible for getting this measure approved by the Union Government, has accepted the post of secretary to the Society for the Preservation of the Fauna of the Empire.

THE Nobel prize for medicine has been awarded to Dr. Johannes Fibiger, professor of pathological anatomy in the University of Copenhagen, who has spent many years in the study of cancer and is best known for his work on the nematode *Gongylonema neoplasticum*. This worm lives in cochroaches, and, when these are eaten by rats, passes into their stomachs, where by the irritation it produces it initiates the growth of malignant tumours. Prof. Fibiger has worked out the whole process in great detail, and thus made notable additions to our knowledge of the relationship of irritation to cancer. Other examples where the irritant is a worm are the cancers of the bladder in man in Egypt caused by Schistosomum and the sarcoma of the liver in rats often associated with the hydatid phase of *Taenia crassicollis*.

CANON J. M. WILSON, who at Rugby and Clifton did much to introduce practical science teaching into schools, and is now in his ninety-first year, must be known to a wide public as having been a consistent champion of evolutionary ideas in religion long before such ideas had become at all popular in theological circles. The earnestness, moderation, and candour of his writings commended evolution to many minds which otherwise would have continued to regard it with dislike and misgiving. A recent pamphlet by Canon Wilson, "Christianity in the Light of the Idea of Evolution" (London: *Guardian* Office), shows that the powers of this veteran apologist have not declined. Indeed, with remarkable acumen, he lays his finger on what certainly are the critical points to-day. The principle of evolution has now been extended beyond the biological sphere to anthropology and psychology, and it is these applications which are causing trouble to many thoughtful people. Religious beliefs are no longer refuted, but explained, as one writer has put it. Yet, as Canon Wilson sees it, the idea of a gradual evolution of belief is a very valuable one, even from the specifically religious point of view. "The evolution of theology," he writes, "may be welcomed; or it may be ignored and hushed up; or it may be disliked and denounced. But it cannot be denied. It is a fact, and a fact of the greatest significance." This evolution of ideas may be [illegible] from another point of [illegible] This conception is [illegible] in [illegible] the Old Testament, which is "the s[illegible] of man's progressive discovery in theology."

IN England this would nowadays be accepted by even conservative scholars; but it is not always realised, as it is by Canon Wilson, that the same principle applies to the New Testament and to the development of the Creeds. In the New Testament there are several quite distinct strata of theological development, and the need for 'restatement' was felt so early as the first century. It is only by disregarding history that the idea of a fixed and final theology becomes possible. The problem now is, as Canon Wilson points out, "to enshrine in a transformed and more elastic framework the old and deep religious experiences expressed in the Bible and the Creeds and other formularies." This is scarcely the place to expand these ideas, but it is gratifying and encouraging for students of science when they see an eminent theologian taking up an attitude of this kind; for even men of science have their religious instincts, which they would be better able to satisfy if the spirit animating Canon Wilson were more widespread. His position is that "religious faith is henceforth to be based on experience and observation; it has become scientific." From this point of view theology must always be secondary, being the interpretation of an experience. In science there are no such things as final interpretations or unchangeable hypotheses; and if the same principle were recognised in religion, religion would share some of the vitality of natural science, and be a great deal more useful to humanity.

WE have received the abstract of a lecture entitled "Life and Mind" which was delivered by Dr. Bernard Hollander before the Ethological Society on October 25. Dr. Hollander is to be congratulated on his courage, for life and mind may be said to be the two ultimate problems of the universe, since only through the senses and minds of living beings do we know anything at all about the universe. He asserts that life and mind are 'forms' of energy—a statement which we think erroneous. Dr. Hollander, indeed, is not comfortable about it himself, for he goes on to say: "If the brain were purely a mechanical apparatus producing mind, we could not be at the same time spectators. Those who think so always look at others. No one considers his own self a piece of mechanism, a part of the universal clockwork." We think that the confusion arises from overlooking the fact that life and mind are presuppositions of all knowledge. What we call 'mind' is a name for our own personality and its activities through which we learn about everything else, energy included. All else is a series of presentations to our mind, presentations which are coloured by its activities. We can no more get outside ourselves and view ourselves from outside than we could lift ourselves out of a marsh by our own waistbands. The first and soundest conclusion which we come to about phenomena, a conclusion arrived at before we reach the mature age of one year, is that many of these

phenomena are the result of the activities of personalities like our own. Other phenomena we gradually perceive are the expression of simpler activities, and our conceptions of matter and energy are all in the last resort pale abstractions from our primary conception of 'selves' For the sake of convenience in classifying phenomena, we neglect this consideration, and affect to regard animals and plants as mere collections of matter and their activities as 'a kind of energy' Life, as Tyndall pointed out long ago, is not energy at all but the control of energy, the constant composition and moulding of energy If in attempting to solve an algebraic problem we should designedly leave out one factor in order to arrive at a simpler solution, we should fully realise that this solution could only be partially true When mechanistic biologists ignore the subjective element in knowledge, their solutions must necessarily be profoundly untrue

IN a lecture to the Royal Geographical Society on November 15, Mr J A Steers discussed some of the changes that are taking place in the coastline between Hunstanton and the Orwell-Stour estuary This is a submerged low coast modified by marine erosion and the action of longshore currents which have dammed several of the streams and elsewhere have led to the growth of spits Mr Steers mentioned an effect of tides which is sometimes overlooked The direction of tidal drift is known to change with ebb and flow, but owing to the difference in level of the water the material worked on at high water is distinct from that worked on at low water so that there often are two opposed movements of beach material on the same foreshore This is noticeable at Blakeney, where the shingle has pushed westward, and the sand, at a lower level eastward Among other interesting points raised in the lecture was the origin of the shingle on the north coast of Norfolk Analysis shows 99 per cent of it to be flint and the remainder to be igneous rock of Scottish and to a less extent Scandinavian origin, with a few fragments of sedimentary rock The prevalence of flint points to an origin not far distant but the exact source is not yet known Mr Steers discussed at some length the origin of Blakeney Point, Lowestoft Ness, Orford Ness, and other recent growths of the coast

To hold an exhibition of coal products during the present stressful period in the coal industry might be considered somewhat hazardous, for exhibitions involve considerable expenditure on the part of exhibitors, but publicity, and especially co-operative publicity, has been found to pay, and nothing seems to daunt the spirits of our industrial firms in good times or in bad The National Coal Products, Chemical, and Engineering Exhibition, which is being held on November 16–27 in Manchester, is a co-operative venture sponsored by the Manchester Section of the Society of Chemical Industry and organised by Provincial Exhibitions, Ltd When planned last May, it was hoped that the coal strike would be ended long before November, but as events proved contrary, the original scheme of confining the exhibition to tar and tar-products was abandoned, and the subject of methods of utilising coal was substituted. As the strike still continued, it was decided also to display many exhibits relating to the value of research upon coal and its products. The list of exhibitors in the City Hall contains the names of the principal organisations that are investigating coal, those of a few chemical firms and a large number of plant manufacturers. Everything possible has been done to attract and instruct the public, and if we are not sure that (as the official catalogue states) all the visitors will feel that in Manchester they are in the actual workshop of the country, and not merely looking into the Empire's shop-window as in London, we are certain that the promoters of the exhibition deserve the thanks of the scientific community for their initiative and enterprise In connexion with the exhibition, a conference on tar is being held on November 26, at which important papers are being read by members of the Society of Chemical Industry, the Institution of Gas Engineers, and the Coke Oven Managers Association

THE Lloyd Roberts Memorial Lecture was delivered at the Manchester Royal Infirmary on November by Dr W E Gye, who chose as his subject "The Cancer Problem" He reviewed his former work and described further experiments, all of which tend to confirm the conclusions he then reached His work has been largely prosecuted with the Rous chicken sarcoma, which, unlike most malignant tumours possesses a 'filterable' virus If a Rous tumour b triturated and filtered through a porcelain filter, th filtrate injected into a fowl induces tumour-formation the causative agent is therefore a filterable or ultra microscopic one If the filtrate be heated to 55° C for 15 minutes, or treated with an antiseptic such a acriflavine before injection, it loses its potency, th causative agent becoming inactivated But if portion of heated filtrate be mixed with a portion filtrate treated with acriflavine and the mixtu injected into a fowl, tumour formation results D Gye concludes, therefore, that the causative agent the Rous tumour consists of two parts, one of whic may be destroyed by heat, the other by an antisept such as acriflavine, and that both are necessary fo tumour formation To the former heat-labile sul stance the name of 'specific factor' is given, th other factor is regarded as being a living virus micro-organism A tumour of one species of anim cannot be transplanted into another, but a mixture inactive Rous tumour extract (inactivated by acr flavine) with extract of human cancer produces in th fowl a tumour microscopically like the Rous tumou Many substitution experiments of this kind have bee performed with similar results, with one or tw curious and inexplicable exceptions only Dr G believes that the specificity or essential characters a malignant tumour are carried by the heat-labi agent called the 'specific factor,' and that the oth factor is a living virus (or viruses) which becom operative only when the specific factor is present well. The fact that cultures in serum broth

tumours (up to the seventh remove) may be substituted for direct extracts in these experiments supports this view. At the same time, other possible, though unlikely, hypothesis are being explored.

THE Factories and Workshops Report for 1925, which was recently issued by H.M. Stationery Office, is instructive and interesting. The work done by the inspectors is very thorough, and the recommendations they have made in previous years have been of great value to the many industries concerned. It seems fairly certain that explosions in works employing benzene and other inflammable products are sometimes caused by electrostatic sparks. This can be prevented in some cases by the use of suitable brush collectors to discharge the electricity on driving-belts. The total number of accidents directly attributable to electricity is 414, and includes 24 fatal cases. This is less than last year; and considering the great increase in the work done in the electrical industry last year it is satisfactory. Twelve of the fatal cases were due to shocks from pressures not exceeding 250 volts. In all these cases alternating current was employed. In one case when a man was inspecting the machinery of a motor car, using a lamp connected with the supply, the lamp broke and the metal car, being insulated from earth by the tyres, became 'alive,' owing to touching a terminal. Although the man was able to call out for the switch to be turned off he was unable to let go and was killed. Another fatal accident was due to a practical joke, the bell handle being connected with one of the supply mains. The worst accidents are caused by a hand to foot shock; the hand, for example, touching the cover of a defective switch, the cover of which has become alive, and the foot making a good contact with the earth through a damp boot. If a person is well insulated from earth he only gets a trifling shock when a spark takes place between him and a high-tension terminal. The present regulations seem quite satisfactory, but they need to be enforced. The senior electric inspector, Mr. G. S. Ram, urges that contractors and others should take special precautions when installing an alternating current supply.

THE increasing facilities rendered available in recent years for the publication of geophysical papers have amply justified themselves, and appear to have greatly stimulated interest and investigation in the subject. In Great Britain the only distinctively geophysical periodical is the *Geophysical Supplement to the Monthly Notices of the Royal Astronomical Society*, and the Society has rendered great service by giving the subject of geophysics this valuable support. The supplement is paged separately from the *Monthly Notices* proper, and forms a distinct journal; it is now nearing the end of its first volume, and No. 7, recently issued, deals in its eight papers with an interesting variety of subjects: seismic waves, the elastic yielding of the earth, the rigidity of its central core, magnetic storms, tidal motion, and the relation between barometric pressure and gas pressure in mines. All these papers have been presented to the Society in the early part of this year. Another thriving journal, also published mainly in English which deals largely but not entirely with geophysics, is the *Japanese Journal of Astronomy and Geophysics*, published by the National Research Council for Japan; beside published papers in full, it gives short abstracts of other cognate papers published in Japan. The recently issued part, vol. 3, No. 3, contains an article on the possibility of gravitational waves in soil, together with no less than 86 abstracts (occupying 33 pages of small print) of other astronomical and geophysical papers.

AN Egyptian wing has been added to the Museum of the University of Pennsylvania, Philadelphia, in memory of the late Mr. Eckley Brinton Coxe, junior. Mr. Coxe was president of the Museum from 1910 until 1916, and was not only a generous benefactor during his lifetime, but also left a sum of half a million dollars at his death for the promotion of Egyptian studies. It will be remembered that extensive investigations at Memphis, including the excavation of the Palace of Merenptah, were carried out by the Eckley B. Coxe Expedition, and many of the objects now installed in the wing and shown for the first time were obtained by this expedition or others on this foundation. A description of the new wing, which was opened in May last, and of some of the principal exhibits, appears in the *Museum Journal* (Philadelphia) for June. It contains twelve rooms appropriate in design and harmonising in colour and proportion with the exhibits. Eight rooms are devoted to Egypt, while Ur, Beisan, Persian art, and Arabic art each have a room, those of Ur and Beisan being used for exhibition of the objects obtained by the expeditions of the Museum now in progress.

THE Sterling fellowships were established by a gift of one million dollars from the trustees of the estate of the late John W. Sterling to stimulate scholarship and advanced research in all fields of knowledge. They are open to graduates who desire to carry on studies under the direction of the Graduate Faculty of Yale University. The fellowships are divided into two general classes: Research or Senior Fellowships for candidates of the standing of the Ph.D. degree, of the annual value of 200*l*.-500*l*.; and Junior Fellowships for candidates who are well advanced in their work towards the Ph.D. degree, of the annual value of 200*l*.-300*l*. All fellows are appointed for a single year in the first instance and are required to submit reports on their work, either at stated intervals or at the expiration of their fellowships. Application forms, to be returned by March 1, can be obtained from the Dean of the Graduate School of Yale University, New Haven, Connecticut.

THE British Museum (Natural History) has issued four additional natural history booklets in the attractive series commenced last year. The new subjects include the pine marten, the harvest mouse, the fallow deer and the barn owl (Price 6*d*. each). As before, each booklet contains a short account of the history and habits of the animal, and is accompanied by a charming coloured illustration. Among

the latest sets of postcards to be published by the Museum is the second series of portraits of famous naturalists (Price 1*s*.). This set includes Sloane, Banks, Leeuwenhoek, Mendel, Seba and Shaw, among others, and a pamphlet enclosed with the set gives concise details of their lives, with special reference to their contributions to natural history. The series of British Museum postcards now covers a wide range of subject and interest, and there can be little doubt that their publication has contributed considerably to the popularity of the institution and to public interest in its collections.

MR. F. G. LLOYD, 1 Sinclair Road, Kensington, W. 14, writes to ask if it is very uncommon now to find the Camberwell Beauty butterfly near London, as a patient had given him a perfect specimen caught near Honor Oak Park Station in the summer of 1911 or 1912. Dr. James Waterston, of the Natural History Museum, South Kensington, has been good enough to send us the following answer to this inquiry: "The Camberwell Beauty is, in Great Britain, a somewhat rare visitor, occurring not in the late spring or early summer (as is commonly the case with other immigrants), but more frequently in August or later. While the species has been proved to hibernate occasionally in Britain, no authentic occurrence of the larva or pupa is on record. 1911 appears to have been a Camberwell Beauty year, and, according to information supplied by my friend Capt. N. D. Riley, the species was then recorded (August) from, amongst other places, Berkhampstead; Bradwell-on-Sea, Essex; Brading, Isle of Wight; Chelsfield, Kent. With all this, the occurrence of the Honor Oak Park Station specimen falls into line. The interest of Mr Lloyd's record is rather a sentimental one, the species on this occasion having been taken, after a long interval, in the locality from which it received its popular name."

THE *Scientific American* for October contains a very discursive but interesting article on "Hunting Fossil Insects," written in the well-known free-lance style of that entomological genius Prof. T. D. A. Cockerell. The insects dealt with are two collections of Tertiary fossils, one from some new beds on the banks of the Kudia river in the Amagu region of Siberia, opposite the southern shores of Sachalin, the other from the Santa Barbara district, Province of Jujuy, Northern Argentina. In each case, Prof. and Mrs. Cockerell underwent an adventurous journey to obtain the specimens, and the chief interest of the article lies perhaps in the illuminating remarks about the conditions of the countries through which they passed. Prof Cockerell has, we believe, dealt with both collections scientifically elsewhere. We think it important to point out that he is in error in assuming that his Argentine Tertiary insects were the first fossil insects to be discovered in the whole of South America. Prof Wieland, of Yale University, discovered two very fine Rhaetic specimens near Mendoza a good many years ago; one of these was a Homopteron and the other a caddis-fly. It was a pity that Prof. Cockerell did not know of this bed, as he might have found further specimens. From the article before us we learn some interesting points about the sect of the "Old Believers," whom, it appears, the Bolsheviks have left somewhat severely alone, so that they still keep their old religion and customs. "Our guide explained that even the Old Believers had had their revolution"; but apparently it was a mild one, as they are still allowed to drink whisky, though tea and coffee are taboo!

SIR ARTHUR KEITH and Mr. C. R. Peers have been elected honorary members of the Yorkshire Philosophical Society.

REPLYING to a question in the House of Commons on November 21, Mr. Amery, Secretary of State for the Colonies, said that the appointment of director of the Amani Institute has been accepted by Mr. W. Nowell, Director of Science and Agriculture, British Guiana. On his arrival in England from British Guiana the new director will be invited to submit recommendations as to the staffing of the Institute.

A PORTRAIT of Michael Faraday, and a reproduction of the portrait of Lord Kelvin painted by Herkomer for the Institution of Civil Engineers, both by Mr. George Harcourt, R.A., will be shown in the lecture theatre of the Institution of Electrical Engineers in the positions allotted to them at the ordinary meeting on December 2. After introductory remarks by the president, Mr. Harcourt's portrait of Faraday will be presented to the Institution by Mr. Sydney Evershed.

AT the annual general meeting of the London Mathematical Society, held on November 11, the following officers were elected: *President*, Prof. G. H. Hardy; *Vice-Presidents*, Prof. S. Chapman, Prof. A. L. Dixon, Mr. J. E. Littlewood; *Treasurer*, Dr. A. E. Western; *Librarian*, Prof. H. Hilton; *Secretaries*, Prof. G. N. Watson, Mr. F. P. White; *New Members of Council*, Prof. H. F. Baker, Prof. A. S. Eddington, Prof. E. H. Neville.

IT is announced in *Science* that the Perkin medal for 1927 has been awarded to Dr. John Teeple, treasurer of the American Chemical Society, for "significant scientific, technical, and administrative achievements, particularly the economic development of an American potassium industry at Searles Lake, Calif." The committee of award consists of representatives of the American Section of the Society of Chemical Industry, the American Chemical Society, the American Electrochemical Society, the American Institute of Chemical Engineers, and the American Section of the Société de Chimie Industrielle.

AT the annual general meeting of the Philosophical Society of the University of Durham, the following officers were elected: *President*, The Earl of Durham (Chancellor of the University of Durham); *Secretary*, Dr. Grace Leitch; *Treasurer*, Mr. J. W. Bullerwell; *Editor*, Dr. Todd; *Librarian*, Dr. Bradshaw; *Assistant Librarian*, Mr. E. Patterson; Sectional Officers, the chairman and secretary of each section being given in brackets: Chemical and Physical (Dr. P. L. Robinson and Mr. O. Darbyshire), Geo-

logical and Biological (Dr. Kathleen Blackburn and Dr. Allan), Mathematical (Mr. Colborne and Mr. Miles), Applied Science (Dr. Morrow and Dr. Baker), Philosophy (Dr. A. Robinson and Mrs. Alderson), Archæological and Historical (Dr. J. Wight Duff).

WE are informed by Messrs. Ernest Benn, Ltd., that Lady Bell is editing the letters of Gertrude Bell, which will be published, probably in two volumes, during the course of 1927.

THE latest catalogue (No. 146) of Messrs. Dulau and Co., Ltd., 34 Margaret Street, W.1, gives particulars of nearly 1300 volumes on zoology, botany and gardening, agriculture, geology, palæontology and mineralogy. Copies can be had free from the publishers.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant in the Engineering School, Trinity College, Dublin—The Registrar (November 29). An assistant master, with qualifications in mathematics, at the Government High School, Nassau, Bahamas—C.A. (T.), Board of Education, Whitehall, S.W.1. For Scottish candidates (T.), Scottish Education Department, Whitehall, S.W.1 (December 6). An officer for research work and a professor of pathology at the Punjab Veterinary College, Lahore—The Secretary to the High Commissioner for India, 42 Grosvenor Gardens, S.W.1 (December 10). Chief designer, designer, chief testing engineer, and first assistant testing engineer at Admiralty Engineering Laboratory, West Drayton—Secretary of the Admiralty (C.E. Branch), Whitehall, S.W.1 (December 13). An instructress in fruit and vegetable preservation, and housemistress of one of the hostels of the Swanley Horticultural College for Women—The Principal of the College, Swanley, Kent (December 15). A bacteriologist in the Department of Agriculture of the Irish Free State—The Secretary, Civil Service Commission, 33 St. Stephen's Green, Dublin (December 16). A principal of the University College of Wales, Aberystwyth, in succession to the late Principal J. H. Davies—The President of the College (D. Davies, Esq., M.P.), Plas Dinam, Llandinam, or The General Secretary, University College, Aberystwyth (January 31). A pathologist at the Cancer Hospital to conduct investigations in the effects of radiation on malignant and normal tissues and body fluids—The Secretary, Cancer Hospital, Fulham Road, S.W.3. A government analyst for the Public Health Department, Southern Rhodesia—The Secretary, High Commissioner for Southern Rhodesia, Crown House, Aldwych, W.C.2. A keeper of the laboratories of the Royal Horticultural Society at Wisley—The Secretary, Royal Horticultural Society, Vincent Square, S.W.1. A temporary assistant in the Research Department, Woolwich, under the Directorate of Explosives Research—The Chief Superintendent, Research Department, Woolwich, S.E.18. An agricultural chemist at the Kirton Agricultural Institute—The Principal, Kirton Agricultural Institute, near Boston, Lincs.

Our Astronomical Column.

COMET COMAS SOLA.—It appears fairly certain from the first ten days' observations of this comet that it is a periodic one, of Jupiter's family. The following orbits are by Mr. G. Merton and Dr. A. C. D. Crommelin respectively:

T	1927, March 2·316 U.T.	1927, March 24·940 U.T.
ω	24° 58′ 20″	37° 0′ 18″
Ω	68 8 14	65 24 50
i	11 50 54	14 0 4
e	0·41065	0·53380
$\log q$	0·20526	0·26290
Period	5^y·525	7^y·789
Equinox	1920·0	1926·0

The elements bear some resemblance to those of Spitaler's Comet, 1890, VII.: ω for that comet was 13° 20′; Ω 45° 6′; i 12° 51′; $\log q$ 0·2596; period 6·4 years. It has not been seen since that apparition. Observations of the present comet are expected to continue for several months, which should decide the question of identity.

BRITISH TELESCOPES.—We have pleasure in directing attention to a recent publication entitled "Astronomical and Optical Instruments" which has been issued by Sir Howard Grubb, Parsons and Company, largely for the purpose of describing and illustrating the resources and equipment of the Company's new optical works at Newcastle-on-Tyne. The contents of the publication consist of a series of four short articles on (1) the development of optical instruments for astronomy and astrophysics; (2) the British optical industry; (3) the history of Sir Howard Grubb, Parsons and Company; (4) the new optical works of the Company at Walker Gate, Newcastle-on-Tyne. The articles are very attractively written, and are well illustrated with a number of clear reproductions. Of special interest are the plans of sectional elevation of the 45-ft. dome and the 41-inch refractor, and two photographs showing the framework of the dome and its rising floor now under construction at the works. Reference to this large telescope and to the optical works in general was made in NATURE of September 4, p. 340. The list on pages 44-45 of some of the principal large astronomical instruments made by the firm since it was founded by Thomas Grubb is eloquent testimony to the debt which astronomy, in particular, owes to these noted makers of telescope objectives and instruments.

EARLY ARABIAN ASTROPHYSICS.—More than 90 pages of volume 56/57 of the *Sitzungsberichte der Phys.-Med. Soz. Erlangen* are devoted to a presentation of the contents of an early Arabic treatise on the Light of the Moon by Al Hazen, with comments by the translator, Dr. Karl Kohl, of the University of Erlangen. Al Hazen, or al Hasen Ibn al Haitham, was born at Basra but spent most of his life in Egypt. He incurred the displeasure of the Calif al Hakim by the failure of his scheme for preventing the flooding of the Nile and had to conceal himself until the death of the Calif in 1020. He then returned to Cairo, where he died in 1038. His book begins with a short account of contemporaneous knowledge as to the light of the moon; he then shows that phases and eclipses necessitate a spherical moon, goes on to describe his own apparatus and observations, shows that neither transmission nor reflection (according to the laws of ordinary reflection) can explain the light, and concludes, therefore, that the moon is self-luminous, the sun imparting by means of its rays the power of self-luminosity. The original treatise appears to be in the India Office, but we have been unable to find any statement as to how it became available for translation.

Research Items.

Promiscuity and Primitive Marriage.—A discussion on promiscuity and group marriage by Lieut.-Col. E. F. Gordon Tucker and Mr. Leslie H. Gilbert appears in the *Sociological Review*, vol. 18, No. 4. Col. Tucker holds that the investigation of marriage must start with the physiological facts of the intensity of the sexual inclination. He argues that while no very helpful lesson can be derived from the varied conduct of the Quadrumana as to the sexual relations of human precursors among savage men, we get on one hand a widespread 'incest horror,' and, on the other, compulsory marriage among close relatives, but not the closest. Yet among Polynesians brother and sister marriage is a source of honour. Postulating a primitive group, the extent of continuity in gregariousness would be dependent on food supply. If the group were constant and sedentary, promiscuity would arise owing to the strength of the sex instinct and the hypothetical absence of the restraining forces of education, law, and religion. It is a question whether sexual jealousy would be strong enough to overcome these forces. Where the group was not constant owing to scarcity of food supply, either permanent or seasonal, individual men going off to find food would each take a woman to perform woman's work—root and beetle grubbing—and this custom would tend to give rise to individual marriage. In these conditions it is unnecessary to postulate promiscuity as a precedent condition of the classificatory system of relationships as Morgan did. The position of the mother's brother follows as a natural result. In his reply Mr. Gilbert argues from the universality of the individual marriage, while the terms of the classificatory system might be deduced from the Levirate and Sororate, which functions actively to-day, and further, that in the marriage groups, eligibility for marriage does not necessarily connote actual sexual relation. The so-called vestigial customs are magico-religious, though no one explanation can account for the diverse sexual orgies. The promiscuity theory demands the abrogation of the parental instinct, both of woman and man, which are essential to the survival of society in view of the conditions of human birth and infancy.

Physical Anthropology of the Pamirs and Amu-Daria Basin.—Physical measurements collected by Sir M. Aurel Stein on his third archæological expedition to Central Asia in 1915, are analysed by Mr. T. A. Joyce in the *Journal of the Royal Anthropological Institute*, Vol. 56, Pt. 1. The measurements are of fourteen different groups covering Mongolo-Turki, Tajik, and Iranian and Persian stock, for the most part nomad pastorals, but including primitive hunters and fishers from the Helmand River and military levies from Baluchistan. The examination of these measurements points to a double grouping into (1) those of the north and north-west—the Yazghulami, Vanji, Darwazi, and Karateghin, relatively dolichocephalic, narrow-nosed, eurypro-sopic and short-statured; and (2) those of the south and south-east—the Shignani, Ishkashmi, and Wakhi, relatively brachycephalic, long-nosed, lepto-prosopic, and tall-statured. Intermediate to these groups are the Roshani, dwellers in a secluded valley, who may be taken as the main element of the bulk of these peoples in its purest form, the pure *Homo Alpinus* type. North and east this type has been modified in various degrees by contact with a broad-nosed Mongolo-Turki type. A Karateghin-Vanji group has been modified by contact with a narrow-nosed branch of Mongoloid peoples, while a Seistani-Sayad group are basically Indo-Persian or Indo-Afghan, but contain a leaven of the old Pamir strain.

Inheritance of Fleece Characters.—Fraser Roberts (*Jour. of Genetics*, 17 1, 1926) has an interesting paper dealing with the genetics of the piebald sheep, described variously as Spanish, or Barbary, or Jacob's sheep. He is of opinion that the characterisation of these sheep in Great Britain has not altered since 1760, and in his experience they invariably breed true, whole black or self-white lambs never appearing. In crosses with English breeds, the F_1 offspring were uniformly self-blacks, and it is concluded from further experimentation that the piebald sheep possesses a dominant black factor and also a recessive factor which restricts the black to certain

Haddock Biology.—Mr. Harold Thompson has recently published the third of an important series of studies on haddock biology (*Fisheries, Scotland, Sci. Invest.* 1926, No. 2. Edinburgh and London: H.M.S.O. 2*s*. 6*d*. net.) In preceding papers it was shown that the acceptance of the "scale theory" for haddock is substantially vindicated by the test of experience, and that few, if any, unsurmountable difficulties occur in its general application to the study of the stock in the sea from year to year. The present paper deals with the growth of sea-born baby haddock reared under artificial conditions in aquaria. Two or three weeks were necessary before the fish accommodated themselves to the new conditions, and this check in growth was marked by an apparent ('false') winter mark on the scale in all cases in which transference of the fish from the sea was carried out during the season of greatest growth, namely, from May to October. Abundant proof was obtained of the unfailing formation of normal winter markings on each occasion that a fish passed through one or two winters in captivity. The experiments also demonstrated the important fact that, for the first three years at least, the size of the haddock scale increases on the average in proportion to that of the fish. The growth under artificial conditions was surprising, for all the captive fish showed an increase of nearly 100 per cent in their growth-rate as compared with controls at sea—a result probably due in large measure to the fact that the food-supply was continuous and plentiful.

Sex Differentiation in Bonellia.—Prof. R. Goldschmidt (*Biol. Zentralbl.*, Bd. 46, Heft 8, 1926) holds that the male Bonellia cannot be regarded simply as a case of neoteny and of suppressed development. Regarded from the point of view of the morphogenesis of the female, the male is by comparison suppressed in development, but from the point of view of sex differentiation the male is an early ripening larva; it is not neotenic like axolotl, but precocious like the larva of Miastor. Prof. Goldschmidt regards the quickening of the sexual differentiation of the male as evidence of the activating function of the secretion on the proboscis of the female, while Baltzer, who places the retardation of metamorphosis in the foreground, takes the opposite view of the action of the proboscis secretion Prof. Goldschmidt, reviewing Baltzer's results, concludes that in Bonellia sex is genetic; those larvæ with the female determinant develop always into females; those with the male determinant which develop as parasites become as a rule males, but after only short parasitism become intersexes; and those developing without parasitism pass through transitory intersexuality into females.

He also examines Baltzer's work from the point of view of developmental physiology and concludes that, before this and the genetical side of the problem can be elucidated, more observations are required.

HOST-PARASITE SPECIFICITY.—Prof. R. W. Hegner (*Science Progress*, Oct. 1926) discusses host-parasite specificity—the association of a particular species of host with a particular species of parasite—with special reference to human protozoa. In many cases a parasitic species appears to be rigidly adjusted to one species of host and unable to live in any other species, *e.g.* the organism of human malaria must often be transferred to horses, cattle, and pigs, but infections do not result. The habits of the host often determine the transmission of human protozoa, *e.g.* insanitary conditions determine largely the spread of intestinal protozoa. The factors within a host which enable natural parasites to bring about an infection but prevent 'foreign' parasites from doing so are briefly considered. Prof. Hegner points out that the conditions within the bodies of anopheline and culicine mosquitoes, and especially of closely allied anophelines, must be very similar, and that therefore the adjustments of the malarial parasites to their insect hosts must be very delicate. The actual factors responsible for the minute differences are unknown but are open to experimental study. In discussing the conditions responsible for differences in susceptibility between young and old, he suggests that some type of resistance develops with age, but the mechanism of this resistance is not known. The termination of an infection with protozoa also probably depends largely on the building up of resistance by the host; failure of the food supply appears to play a minor part. A more extensive account of the biology of host-parasite relationships, with special reference to the protozoa living in man, is given by Prof. Hegner in *Quart. Review of Biol.*, 1, 3, 1926.

PROBLEMS OF VEGETATIVE PROPAGATION.—Dr. R. C. Knight makes an interesting contribution to our knowledge of conditions under which hard-wood cuttings can be successfully propagated as a result of his experiments, mainly with plum stocks, reported in the *Journal of Pomology*, vol. 5, pp. 248-266, October 1926. He concludes that the amount of callus formation is not necessarily indicative of the amount of root production, these two processes bearing no consequential relation to one another. They are not similarly affected by external conditions: thus callus formation is favoured by a high water content in the soil, while root production, on the other hand, may be better with a lower water content, because the lower water content permits more efficient aeration. Treatment of the tissue of the cuttings with various reagents was attempted, but on the whole the results of such treatments were irregular and never so favourable as to give a hint of a method of practical importance.

THE FALL OF FLORAL ORGANS.—Isawo Namikawa has investigated fully the details of the abscission or exfoliation of floral organs, and publishes many details of interest in the *Journal of the College of Agriculture*, Hokkaido Imperial University, 27, pp. 63-131, July 1926. Catkins particularly have formed the subject of study, and in every case a more or less differentiated separation zone is present. Except in the fertilised female cone of Alnus, abscission takes place in all catkins examined. By abscission is understood a separation brought about by living tissue; exfoliation is the term given to the falling of floral organs as the result of drying and death, with separation following mechanical rupture. In Narcissus, Lycoris, Menyanthes, and Ribes, the floral organs are thus exfoliated as the result of ligno-suberisation of a more or less differentiated cell-layer at the base of the floral organ. The female cone of Alnus falls with a part of the vegetative shoot when this is cut off by abscission.

EARTHQUAKES IN FRANCE.—The earthquakes of France, studied in past times by Perrey (1872) and Montessus de Ballore (1892), have lately attracted closer attention. For a valuable summary of recent investigations we are indebted to M. Edmond Rothé, director of the French Seismological Bureau (*Matériaux pour l'étude des calamités*, No. 9, 1926, pp. 3-47). During the seven years 1919–25, the number of earthquakes felt in the whole of France was 79, the yearly average being thus about the same as in Great Britain. Of the six seismic regions which M. Rothé defines, the more prominent are those of the Alpes Maritimes and the valley of the Rhône, and of the Pyrenees, in the former of which were felt the Riviera earthquake of 1887 (of Italian origin) and the Provence earthquake of 1909, an earthquake of special interest, as the ground in the central region seems to have been elevated by about $1\frac{1}{2}$ inches.

OIL AND COAL RESOURCES OF THE OREGON BASIN, WYOMING.—The area covered by this geological survey (the work of D. F. Hewett, *U.S. Geol. Sur. Prof. Paper* 145) lies along the west side of the well-known Big Horn Basin in north-western Wyoming. Stratigraphically, the Carboniferous, Jurassic, Cretaceous, and Tertiary systems are represented; coal deposits, mainly of a lenticular character, occur in the Montana members of the Upper Cretaceous, also in the Fort Union formation of middle Tertiary age; petroleum is mainly derived from the Frontier member of the Upper Cretaceous, and is exploited particularly at the Grass Creek field. Apart from detailed studies of these natural resources, this monograph is of interest for the attention which is given therein to the analysis of the sediments involved. In particular 'bentonite,' a peculiar clay with some unusual properties and of widespread occurrence in the Rocky Mountain region, receives discussion; from mineralogical and mechanical analyses the author concludes that this substance is the alteration product of a volcanic glass, or at least partially derived from some mineral which was crystallised in the glass. It would seem that the alteration ensued soon after explosive phases of vulcanicity had taken place, vapours being condensed and gathering particles into drops, thus producing mud-showers, ultimately forming the clay; the volcanoes responsible for the mother-substance of bentonite were probably situated in the region west of Wyoming, possibly in central Idaho. The mineralogical analyses of other sediments are clearly not exhaustive, most of the 'heavy' mineral constituents being disregarded, except biotite, apatite, and zircon, where these species occur; it is quite certain that further investigation of such accessories would have served the author's purpose still better, "in the hope that . . . additional light on the character, source, and manner of deposition of the sediments" would be forthcoming. This monograph is rich in diagrams, photographs, and maps, but the mass of detail, the absence of any introductory abstract of essential geology and economics, and the omission of any summary make it difficult reading.

SPECTRA OF HEAVY METALS.—Vol. 2, No. 6, of the *Proceedings of the Imperial Academy of Japan* contains preliminary notes of some spectroscopic investigations. The fine structure of several bismuth lines has been examined by Nagaoka and Mishima by means of crossed Lummer-Gehrcke plates, and tables

of wave-length intervals are given. By exciting the spectra of thallium and gold by means of high tension and heavy current (20 kv. and 1 ka.) Nagaoka and Futagami find that new lines are produced in almost coincident positions for the two metals. They give also a considerable list of almost coincident lines for these substances taken from existing measures, and point out that gold and thallium respectively could be produced from mercury if a proton could be expelled from or introduced into the mercury nucleus. The same experimenters record also the spectra of mercury produced by two different types of explosion.

IMPROVED SPECTROGRAPHS AND SPECTROMETERS.—Messrs. Hilger's supplementary catalogue describes a considerable number of improvements to existing forms of instrument and includes also particulars of apparatus of new type. Among the latter is a new range of spectrograph with interchangeable optical systems containing plane or concave grating, or prism (glass or quartz). Each model is made in three sizes, for focal lengths of 100, 150, and 300 cm. respectively. A large aperture glass spectrograph, giving small dispersion, for use with faint sources, should commend itself to many investigators. A special spectroscope is made also for the rapid detection of foreign metals in steel, and is in use in important steel works in Great Britain and America. Visual observation of ultra-violet radiation can be made by an instrument similar in form to the well-known Hilger small quartz spectrograph, but provided with a fluorescent screen above which is fixed a wave-length scale. The instrument is in constant adjustment. Numerous improvements in the constant deviation wave-length spectrometer have been embodied in the "1926 Model." The older form of the instrument ("Standard Model") is, however, still available at a slightly lower price.

ELECTRONIC STRUCTURE OF THE ATOM.—The lecture recently delivered by Prof. A. Sommerfeld at Manchester has been reprinted, under the title of "Electronic Structure of the Atom and the Quantum Theory," from vol. 70 of the *Memoirs and Proceedings of the Manchester Literary and Philosophical Society*. After outlining the main features of the present view of electronic orbits in the atom, Prof. Sommerfeld goes on to consider the relation of atomic structure, as revealed by spectroscopy, to chemistry. He attaches great importance to the work of Main Smith and Stoner in dividing the energy levels characterised by given principal and azimuthal quantum numbers (n_k) into sub-groups distinguished by the value of the inner quantum number, j. Chemical combination is considered to be determined by the tendency of an atom to complete its outermost shell of electrons, and there is considerable evidence that the tendency to complete a sub-group, n_{kj}, is effective in this respect, as well as the tendency to complete a group, n_k. From such considerations, many of the observed chemical combinations which otherwise appear to be inexplicable receive a natural interpretation (see also NATURE, June 5, p. 793).

THE INERTIA OF THE ELECTRIC CARRIER IN COPPER.—In the October number of the *Physical Review*, R. C. Tolman and M. Mott-Smith describe a comprehensive series of experiments designed to study the inertia of the electric carrier in copper. They used an apparatus similar to that used in the experiments of Tolman, Karrer, and Guernsey, in which a copper cylinder was oscillated about its axis, and the current due to the lag of the electrons in the cylinder was detected by means of a coil of many turns of fine wire connected through an amplifier to a tuned vibration galvanometer. In order to determine the phase of the effect, the alternating electromotive force in the coil was balanced against an alternating electromotive force produced in an earth inductor which rotated in synchronism with the oscillation of the cylinder, so that adjustments of the amplitude and phase of the balancing electromotive force were possible. An exhaustive investigation of the effect of the earth's field on the magnitude and phase of the effect was also made. It was found that the actual magnitude of the electromotive force observed was 19 per cent. less than that expected on the simple theory in which the effective mass of the carrier was assumed to be that of an electron in free space. The average phase of the observed electromotive force lagged 10° behind the acceleration, whereas on the simple theory it should be in unison.

OPTICAL PROPERTIES OF SUGARS.—The *Journal of the Washington Academy of Sciences* for October 4 contains a short paper on the optical properties of *l*-arabinose, fructose, *d*-glucose hydrate, α-lactose hydrate, lyxose, *d*-mannose, *d*-melibiose, raffinose, rhamnose monohydrate, *d*-ribose, sucrose, trehalose and *d*-xylose, giving the refractive indices determined by the immersion method in mixtures of mineral oil and monochloronaphthalene, in yellow light. The behaviour in polarised light between crossed nicols is also listed, as well as the appearance of the crystals. The work is due to G. T. Keenan, of the Bureau of Chemistry.

TECHNIQUE IN ENZYME INVESTIGATION.—In *Die Naturwissenschaften* for October 15, appears an interesting résumé by R. Willstätter of the methods and results of the work upon enzymes proceeding under his direction at Munich. Willstätter emphasises the point that though the enzyme system is colloidal it is also a complex organic substance the chemical composition of which is of first importance in understanding its behaviour. Thus, as a catalyst, an enzyme is frequently very specific in its action, and undoubtedly chemical structure must be accountable for such specific action on saccharose as R. Kuhn is reported to have found. Unpublished experiments suggest that there are glucosaccharases and fructosaccharases that can be isolated from fungi which, as their name suggests, attack the biose by linkage on to different constituent hexose molecules. Willstätter discusses the problem of isolation of enzymes and describes methods by which, within one day, invertase preparations can be obtained 300–500 times purer than previously. The invertase content in yeast can be increased 15–20 times by allowing it to ferment at the lowest possible sugar concentration for a day. This result raises a doubt whether conclusions can be drawn from the natural presence of an enzyme as to its significance to the organism. An account is also given of the method of purification by adsorption and regeneration of the enzyme from the adsorbent which has been developed with so much success at Munich. In this connexion, Willstätter points out that the suspended hydrates of alumina are by no means simple inorganic complexes; a whole series of compounds is possible, different in their amount of chemically combined water and in their general properties, including their behaviour as adsorbents. Thus "alumina γ" adsorbs lipase, leaving trypsin and anylase in solution; "β alumina," on the other hand, also adsorbs the trypsin. Many other interesting examples are given and the difficulties are discussed that lie in the way of attempts to estimate enzyme quantities in view of the many factors modifying the kinetics of an enzyme catalysed reaction.